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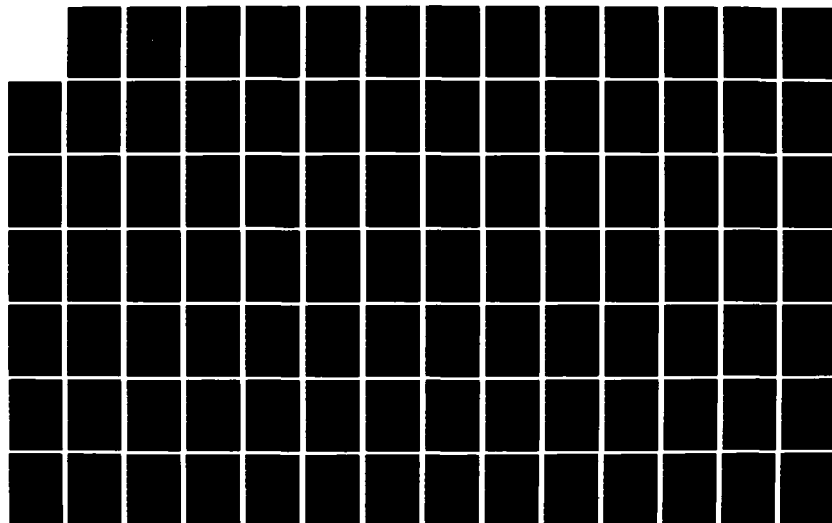
EMC (ELECTROMAGNETIC COMPATIBILITY) STANDARDS HANDBOOK
REVISION 4(U) ELECTROMAGNETIC COMPATIBILITY ANALYSIS
CENTER ANNAPOLIS MD R B SCHULZ NOV 82 ECAC-HDBK-82-043
F19628-80-C-0042

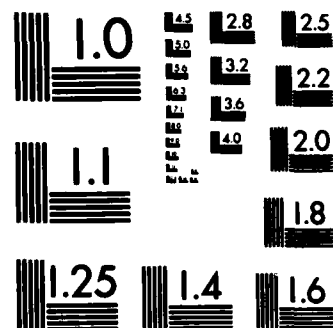
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DEPARTMENT OF DEFENSE
Electromagnetic Compatibility Analysis Center
Annapolis, Maryland 21402

EMC STANDARDS HANDBOOK

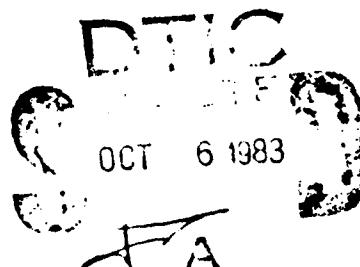
Revision 4



NOVEMBER 1982

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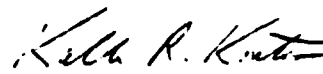
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This report has been reviewed and is approved for publication.

Reviewed by

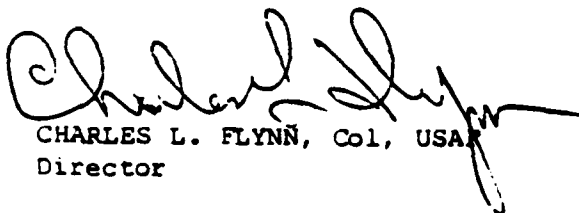


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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Information on EMC-related standards, specifications, handbooks, and regulations is presented that includes bases, scopes, interrelationships, and applications. Emphasis is on DoD documents, although non-DoD documents are also included. Among the other categories are NATO, Federal, voluntary, foreign national, and international documents. Technical disciplines covered include EMC and RADHAZ with lightning added (not separately listed). Although many areas of application are included, emphasis is placed on DoD (continued on next page)		

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20. ABSTRACT (Continued)

tactical and long-haul communications.

New material in this fourth revision includes 53 substantive changes in table entries and related text. Also, a section on major features of EMC-related standards was deleted due to obsolescence. Two valuable additions are indexes by numbers and subjects of standards. The number of documents cited is 222.

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TABLE OF CONTENTS

<u>Subsection</u>	<u>Page</u>
SECTION 1	
GENERAL	
PROLOGUE.....	1-1
Introduction.....	1-1
Purpose.....	1-7
BACKGROUND.....	1-7
Standards, Specifications, Handbooks, and Regulations.....	1-7
Application of EMC Standards.....	1-9
DoD Policy Objectives on Applications of Standards and Specifications.....	1-10
DoD Policy on Tailoring.....	1-11
DoD Policy on Adoption of Voluntary Standards.....	1-13
DoD Electromagnetic Compatibility Standardization (EMCS) Program.....	1-13
SECTION 2	
U.S. NATIONAL EMC/RADHAZ STANDARDIZATION AND REGULATION	
DoD STANDARDIZATION.....	2-1
DoD-RELATED STANDARDIZATION.....	2-1
FEDERAL AGENCIES ISSUING EMC-RELATED STANDARDS/REGULATIONS.....	2-13
VOLUNTARY EMC/RADHAZ STANDARDIZATION.....	2-16
American National Standards Institute (ANSI).....	2-16
Computer and Business Equipment Manufacturers Association (CBEMA).....	2-19
Electronic Industries Association (EIA).....	2-19
Institute of Electrical and Electronics Engineers (IEEE).....	2-19
Instrument Society of America (ISA).....	2-19
National Electrical Manufacturers Association (NEMA).....	2-20

TABLE OF CONTENTS (Continued)

<u>Subsection</u>	<u>Page</u>
SECTION 2 (Continued)	
Radio Technical Commission for Aeronautics (RTCA).....	2-20
Scientific Apparatus Makers Association (SAMA).....	2-20
SAE (formerly Society of Automotive Engineers).....	2-20
RADIO SERVICES AND APPLICABLE STANDARDS/REGULATIONS.....	2-21
Communications.....	2-21
Navigation.....	2-36
Noncommunication Devices.....	2-37

SECTION 3

FOREIGN NATIONAL EMC STANDARDIZATION AND REGULATION

INTRODUCTION.....	3-1
GERMAN INTERFERENCE-CONTROL LAWS.....	3-1
VDE Organizations.....	3-1
VDE Testing Station.....	3-2
CANADIAN EMC STANDARDS.....	3-3
BRITISH EMC STANDARDS.....	3-6
JAPANESE INDUSTRIAL STANDARDS.....	3-10

SECTION 4

INTERNATIONAL EMC STANDARDIZATION

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC).....	4-1
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO).....	4-1
INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR).....	4-1
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE (CISPR).....	4-2
INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (CCITT).....	4-2

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
2-1	Organization chart of DoD directives and standards pertaining to EMC.....	2-2
4-1	Role of EMC standards activities leading to national or international standardization.....	4-3

LIST OF TABLES

<u>Table</u>		
1-1	MAJOR CHANGES IN LISTED STANDARDS.....	1-2
2-1	DOD EMC, STANDARDS SPECIFICATIONS, AND HANDBOOKS.....	2-2
2-2	DOD RADHAZ STANDARDS, SPECIFICATIONS, AND HANDBOOKS.....	2-8
2-3	DOD COMMUNICATIONS STANDARDS AND HANDBOOKS CONTAINING EMC PROVISIONS.....	2-10
2-4	DOD MISCELLANEOUS STANDARDS AND SPECIFICATIONS CONTAINING EMC AND RADHAZ PROVISIONS.....	2-11
2-5	NATO STANAG'S ON EMC STANDARDS, SPECIFICATIONS, AND HANDBOOKS.....	2-14
2-6	FEDERAL STANDARDS AND REGULATIONS.....	2-17
2-7	U.S. VOLUNTARY EMC/RADHAZ STANDARDS.....	2-22
3-1	EMC-RELATED STANDARDS OF WEST GERMANY.....	3-4
3-2	EMC-RELATED STANDARDS OF CANADA.....	3-7
3-3	EMC-RELATED STANDARDS OF GREAT BRITAIN.....	3-8
4-1	INTERNATIONAL EMC-RELATED STANDARDS.....	4-3

TABLE OF CONTENTS (Continued)

LIST OF APPENDIXES

<u>Appendix</u>		<u>Page</u>
A	SUMMARY OF MIL-STD-461B REQUIREMENTS.....	A-1
B	DOD COMMUNICATIONS STANDARDS CONTAINING NO SPECIFIC EMC PROVISION.....	B-1
R	LIST OF REFERENCES.....	R-1
I	CITATIONS INDEXES.....	I-1
	Citations Alpha-Numeric Index.....	I-1
	Citations Subject Index.....	I-11

SECTION 1

GENERAL

PROLOGUE

Introduction

This fourth revision of the EMC Standards Handbook contains updated and additional material received since the publication of its predecessor. Previous editions of this handbook should be destroyed. The updated material resulted in 53 substantive changes in table entries of the Handbook, as well as corresponding changes in the text; the most significant tabular changes are summarized in TABLE 1-1. Citations in the tables total 222 items. These may be readily located by the use of two new indexes, one organized according to document number and the other organized according to subject.

The remainder of this introductory section is concerned with some relevant background material and a preview of the handbook contents. The development, deployment, and operation of DoD communications-electronics (C-E) systems require adherence to numerous development standards and to various operationally oriented standards, specifications, and regulations. Depending upon the complexity of the system or equipment, the number of standards applied could reach into the hundreds. Without exception, if the system or equipment is designed to transmit and/or receive, some of these standards as well as specifications and regulations will relate in some way to the electromagnetic compatibility (EMC) of the device in its operational environment.

Some standards and related documents are readily recognized by the use of the term electromagnetic compatibility either in their titles or prominently in their texts. The application of others may not be so patent. It is the purpose of this handbook to bring together, under one cover, a list of documents that can be used to effect compatibility among equipments and systems that have the potential for interfering one with the other.

TABLE 1-1
MAJOR CHANGES IN LISTED STANDARDS
(Page 1 of 4)

<u>Table</u>	<u>No./Date</u>	<u>Title</u>	<u>Comment</u>
<u>DEPARTMENT OF DEFENSE</u>			
2-1	MIL-STD-449D 2/23/73	Measurement of Radio Frequency Spectrum Characteristics	Revision postponed
2-1	MIL-STD-461B 4/1/80	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference	Notice being drafted
2-1	MIL-C-85485 9/16/81	Cable, Electric, Filter Line, Radio Frequency Absorptive	New specification
2-1	MIL-HDBK-255-1A (NAVY) 2/15/79	Electromagnetic (Radiated) Environment Considerations for Design and Procurement of Electrical and Electronic Equipment, Subsystems and Systems: Part 1A	Revised draft (new tables) due FY82
2-2	AFOSH 161-9	Exposure to Radio Frequency Radiation	Deleted; not DoD-level document
2-2, 2-7	ANS Z136.1-1980	American National Standard for the Safe Use of Lasers	Adopted by DoD 6/6/80

TABLE 1-1
(Page 2 of 4)

<u>Table</u>	<u>No./Date</u>	<u>Title</u>	<u>Comment</u>
2-4	DoD-STD-1686 5/2/80	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	New standard
2-4	MIL-R-9673B 4/4/60 Amend. 2, 9/15/61	Radiation Limits, Microwave and X-Radiation Generated by Ground Electronic Equipment	New listing

NORTH ATLANTIC TREATY ORGANIZATION

2-5	NAT-STD-2345 12/16/79	Control and Recording of Personnel Exposure to Radio-Frequency Radiation	New listing
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AMERICAN NATIONAL STANDARDS INSTITUTE

2-7	ANS C95.4-1981 IME Pub. 20	Safety Guide for the Procurement of Radio Frequency Hazards to Electric Blasting Caps	Revision
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

2-7	IEEE 291-1969	Measuring Field Strength in Radio Propagation, Standards Report on	New listing
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TABLE 1-1
(Page 3 of 4)

<u>Table</u>	<u>No./Date</u>	<u>Title</u>	<u>Comment</u>
2-7	IEEE 302-1969	Electromagnetic Field Strength for Frequencies Below 1000 MHz in Radio Wave Propagation, Standard Methods for Measuring	New listing
2-7	IEEE 377-1980	IEEE Recommended Practice for Measurement of Spurious Emission from Land-Mobile Communication Transmitters	New standard

INSTITUTE OF MAKERS OF EXPLOSIVES

2-7	IME Pub. 20 9/81	See ANSI, ANS C95.4-1981	Revision
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RADIO TECHNICAL COMMISSION FOR AERONAUTICS

2-7	RTCA D0168- 1979	Minimum Performance Standards -- Emergency Locator Transmitters	New listing
2-7	RTCA D0176- 1982	FM Broadcast Interference Related to Airborne ILS, VOR and VHF Communications	New standard

SAE (formerly Society of Automotive Engineers)

2-7	SAE AIR 122S,	Spectrum Analyzers for EMI Measurements	Withdrawn
-----	---------------	--	-----------

TABLE 1-1
(Page 4 of 4)

<u>Table</u>	<u>No./Date</u>	<u>Title</u>	<u>Comment</u>
2-7	SAE ARP 1267 - 1973	Electromagnetic Interference Impulse Generators; Standard Calibration Requirement and Techniques	New listing
2-7	SAE J/1338 6/81	Open-Field Whole-Vehicle Radiated Susceptibility 10 kHz to 18 GHz, Electric Field	New standard
<u>FEDERAL REPUBLIC OF GERMANY</u>			
3-1	VDE 0871 11/81	Radio-Frequency Interference Suppression of Radio-Frequency Equipment for Industrial, Scientific, and Medical (ISM) and Similar Purposes	Revision
<u>CANADA</u>			
3-2	CSA Z65-1966	Radiation Hazards from Electronic Equipment	New listing
<u>INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE (CISPR)</u>			
4-1	CISPR 17-1981	Methods of Measurement of the Suppression Characteristics of Passive Radio Interference Filters	New standard

The ECAC engineer is often placed in the position of advising developers as to existing standards and specifications that can be incorporated into Requests for Proposal (RFP's) and into Contract Specifications. This handbook provides a single source of these, along with a precis of each, to enable the engineer to estimate their applicability. The implementation is discussed later in this Section.

Section 2 is devoted to U.S. documents including standards, specifications, and handbooks primarily applicable to DoD systems with emphasis on communications. For completeness, those that contain no EMC provision are given in APPENDIX B. Also listed are nonmilitary agencies of the federal government that issue EMC-related standards and regulations.

Nongovernment agencies in the U.S. publish EMC-related standards, termed "voluntary" standards. Both issuing organizations and their standards are likewise presented in Section 2. These standards are used not only by civilian organizations, but some are being approved for use by the federal government.

Also listed in Section 2 are various types of U.S. civilian radio services together with the standardizing and regulating documents that apply.

Foreign national EMC standards and regulations are provided for the Federal Republic of Germany, Canada, and Great Britain in Section 3. For Japan, only an introduction is provided.

Voluntary standards are also issued by international standards organizations, as presented in Section 4. They are not the same as national voluntary standards, although there is a slow evolution toward commonality. International standards are widely, but not universally, adopted among the European countries, sometimes with minor variations.

A summary of receiver test requirements of all classes of standards is contained in Section 5. This listing provides the reader with a quick comprehension of the susceptibility provisions of many standards and related documents.

A summary of the basic MIL-STD-461B requirements is contained in APPENDIX A. This summary consists of an application sheet for each of the 21 test procedures upon which the limits are based.

Purpose

This document is a basic EMC Standards Handbook that indexes and summarizes characteristics of EMC-related standards, specifications, handbooks, and regulations for use as a handy reference by ECAC project engineers. This handbook also provides pertinent background information on the DoD EMC Standardization Program.

BACKGROUND

Standards, Specifications, Handbooks, and Regulations

Technical standards constitute a body of good engineering practice in the subject area concerned. They are generated primarily under the auspices of the U.S. Department of Defense (DoD), non-DoD government, national civilian engineering societies, and international organizations as well as foreign governments. Nongovernment entities promulgate "voluntary" standards, those without legal authority for compliance. Some of these eventually achieve legal status by means of international treaty agreements. Some are adopted as government (both DoD and non-DoD) standards. EMC standards are often developed separately to serve unique military needs and form the main thrust of this handbook.

Because technical standards represent good engineering practice, many are cited as broad technical requirements of contracts and thus achieve legal

status for the specific applications concerned. For this reason, they are sometimes confused with technical specifications that are intended to be used as contractual requirements. These technical specifications generally embody narrower, more-detailed requirements for specific applications. Two classes of specifications exist, 1) those that impose performance requirements and 2) those that impose construction requirements. Specifications listed here fall mainly in the former category.

Although standards and specifications detail requirements to be met, they do not tell the user how to meet them. However, handbooks help to fill this void by providing generalized technical design data and guidance.

EMC regulations have legal status and are used by government agencies to control undesired electromagnetic (EM) interactions. Two primary agencies regulate radio communications and related services; these are the Federal Communications Commission (FCC) and the National Telecommunication and Information Administration (NTIA). The FCC regulates systems in the civil sector, including state governments, whereas NTIA performs an analogous function for the federal government, including the FCC. FCC and NTIA actions are, of course, coordinated. Other federal agencies also impose special requirements; for example, maximum permissible RF exposure levels for workers are set by the Occupational Safety and Health Administration (OSHA).

Application of EMC Standards

EMC standards, as any other type, serve various purposes. Reasons for applying them include the following:

1. To ensure that various portions of a system operate without electromagnetic interference to any other portion of the same system (intrasystem electromagnetic compatibility)

2. To ensure that different systems operate without electromagnetic interference to each other (intersystem electromagnetic compatibility)
3. To ensure that a system does not degrade the electromagnetic environment, and that it is not degraded by the environment
4. To add to the measured EMC data base
5. To aid in management of the RF spectrum
6. To aid cost-effective design whereby costly retrofit is unnecessary
7. To comply with national and international law during times of peace.

Where and when EMC standards are applied is almost (but not quite) obvious from the types of standard involved: a) DoD standards apply to military systems, b) non-DoD government standards and regulations apply throughout the civil federal government, and c) national standards apply to the nations concerned. Not so obvious are certain applications to DoD radar systems. For those non-Air Force systems operating between 100 MHz and 40 GHz, MIL-STD-469 applies. (The Air Force uses the NTIA radar systems emissions criteria [RSEC]). Below 100 MHz, no specific radar standard exists; the overall EMC standards MIL-STD-461/2/3 apply. Also, sometimes there is confusion concerning when DoD standards or NTIA or FCC regulations apply to some given situation. For military systems, DoD standards always apply unless some other basis is specifically referenced. Some other basis might be NTIA regulations, voluntary-type standards of professional organizations (Institute of Electrical and Electronics Engineers - IEEE, SAE (formerly Society of Automotive Engineers), standards of a coordinating body (American National Standards Institute - ANSI)), and standards of other national and international bodies (Association of German Electrical Engineers - VDE, North Atlantic Treaty Organization - NATO, International Special Committee on Radio Interference - CISPR). On the other hand, NTIA regulations apply to all

federal government systems. State government and civilian systems abide by regulations of the FCC.

To the extent that standards and specifications become incorporated into contracts between DoD and industry, their provisions are legally binding upon the contractor (and DoD). When inadequately designated or improperly followed, they often lead to increased costs and delays in the introduction of new hardware. In the past, such requirements frequently had been waived (after the fact) by DoD project managers who were pinched by budget constraints, rising costs, and scheduling delays.

DoD Policy Objectives on Application of Standards and Specifications

A recent change in DoD policy¹⁻¹ with respect to the application of standards and specifications is not yet fully appreciated by many users. Let us attempt to explain the new policy in the light of former policy and current associated philosophy.

Former policy and associated philosophy involved "past emphasis on achieving maximum performance without regard to cost, to the institutionalized attitude that specifications and standards were mandatory and had to be applied in their entirety, and to the lack of emphasis on the proper application and tailoring of documents to a specific need" (see Reference 1-1).

This situation was recognized and resulted in a policy change. Under the new policy (see Reference 1-1), the provisions of standards and specifications are to be tailored for each given materiel acquisition. Tailoring is defined in the Directive as (see Reference 1-1):

¹⁻¹Department of Defense Specifications and Standards Applications, DoD Directive 4120.21, Washington, DC, 9 April 1977.

The process by which the individual requirements (sections, paragraphs, or sentences) of the selected specifications and standards are evaluated to determine the extent to which each requirement is most suitable for a specific materiel acquisition and the modification of these requirements, where necessary, to assure that each tailored document invoked states only the minimum needs of the Government.

By so doing, the objective is to make all levels of management aware of the need to assure more cost-effective utilization of specifications and standards in materiel acquisition; that specifications and standards are susceptible to selective application and tailoring to a particular program; and that these documents must be applied and tailored by giving due consideration to required performance versus costs and achievement of minimum required operational needs.

DoD Policy on Tailoring

For large systems, selected and modified requirements were made a part of a control plan that became a contractual document to supersede standards and specifications. Thus, tailoring was actually being practiced in the development and design of many large systems,¹⁻² but the misapplication and insufficient tailoring of specifications and standards in defense acquisition programs sometimes have led to increased costs and delays in the introduction of new hardware.

Obviously, this situation needs improvement. To this end, application of the tailoring process of DoD components is to consist of the following elements (see Reference 1-2):

- A. Specifications and standards used in acquisition programs shall be selectively applied and tailored to impose the minimum essential system needs.

¹⁻²Department of Defense, Tailoring Guide for Application of Standards and Specifications in Naval Weapons Systems Acquisitions, MIL-HDBK-248, Washington, DC, 1 April 1977.

- B. Data requirements to be imposed in acquisition programs shall be consistent with the tailored requirements imposed by the governing specifications and standards and the policies enunciated in DoD Directive 5000.19.¹⁻³
- C. The blanket contractual imposition of specifications and standards in acquisition programs shall be avoided and controlled to the maximum practical extent.
- D. A management review board shall examine all acquisition programs to assure that the specifications, standards, and Data Item Descriptions used have been tailored.
- E. The results of the document application and tailoring process shall be made a matter of permanent record, certified, and made available to the review board.
- F. When consistent with the proposed procurement method ... recommendations or comments shall be solicited from prospective contractors during the acquisition process to determine whether additional cost-effective application and tailoring of cited specifications and standards can be accomplished, or cost-effective substitutions proposed.

The portent of the tailoring policy to ECAC project engineers is to decrease the usefulness of standards as a generic source of EMC requirements, unless access is also available to the permanent record of any given tailoring application (Item E above). Since a record does not exist for systems yet to be developed, the margin of uncertainty for them in the usefulness of limiting values in standards is increased.

DoD Policy on Adoption of Voluntary Standards

For many years, DoD has had a policy to adopt the standards of non-government organizations (called voluntary standards) instead of using federal standards, where applicable. This policy has been only rarely followed until recently. Now, a concerted effort exists to adopt such standards in order to

¹⁻³ Department of Defense, Policies for the Management and Control of Information Requirements, DoD Directive 5000.19, Washington, DC, 12 March 1976.

save money in procurement, notwithstanding the savings in not generating and updating standards. (Even a modest-sized standard is estimated to cost over \$100,000 to produce.)

The implication of this trend is that voluntary standards are becoming more important due to wider application. Thus, a significant portion of this handbook deals with them.

DoD Electromagnetic Compatibility Standardization (EMCS) Program

The DoD Directive 3222.3¹⁻⁴ established the DoD Electromagnetic Compatibility Program and placed the responsibility for standardization with the Secretary of the Navy or his designee. The Office of Technical Data, Standardization Policy, and Quality Assurance (I&L) designated the Naval Electronic Systems Command as the Area Assignee Activity for EMC in its memo of 31 August 1967. The scope of the Electromagnetic Compatibility Standardization Program (EMCS) was revised by OASD (DIECO) in their memo of 20 May 1972 to read as follows:

. . .complete range of component, circuit, equipment, subsystem and system electromagnetic compatibility (EMC). Included are: 1) related standards for prediction, measurement, and validation for EMC and 2) standardization activities for electromagnetic radiation hazards as related to personnel, ordnance, fuels, and electronic hardware.

Action is being taken to coordinate the EMCS with other DoD and government agencies concerned with EMC and radiation hazards, such as the Federal Communications Commission (FCC), Federal Aviation Administration (FAA), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), Defense Nuclear Agency (DNA), National Telecommunications and Information Administration (NTIA), National Bureau of

¹⁻⁴Department of Defense Department of Defense Electromagnetic Compatibility Program (DTACCS), DoD Directive 3222.3, Washington, DC, 5 July 1967 (Change 1, 27 September 1972).

Standards (NBS), Bureau of Radiological Health (BRH), and the General Services Administration (GSA). International standardization efforts in the EMC area are also being monitored through participation in NATO and International Electrotechnical Commission standards groups.

Industry is being kept abreast of activities in this program and will continue to be informed of developments and documents in the EMCS through the various industry associations, such as Aerospace Industries Association (AIA), American National Standards Institute (ANSI/C63 and C95), Electronic Industries Association (EIA/G46), Radio Technical Commission for Aeronautics (RTCA), SAE (SAE/AE-4), and the Institute of Electrical and Electronics Engineers (IEEE/S27).

SECTION 2

U.S. NATIONAL EMC/RADHAZ STANDARDIZATION AND REGULATION

DoD STANDARDIZATION

DoD EMC standards, specifications, and handbooks are related in accordance with Figure 2-1. The initial part of the document number for standards is MIL-STD-; for specifications, MIL-X-, where X is a letter identifying the technical area (E for electrical); and for handbooks, MIL-HDBK-.

In the tables that follow, standards are positioned first, specifications second, and handbooks third. The tables encompass the following subject areas:

<u>Table</u>	<u>Subject</u>
2-1	Basic Electromagnetic Compatibility (EMC)
2-2	Basic Radiation Hazards (RADHAZ)
2-3	Basic Communications with EMC Requirements
2-4	Miscellaneous Subject Areas with EMC and RADHAZ Requirements

For comprehensive guidance in the RADHAZ area, refer to the Radiation Hazards Handbook.²⁻¹

DoD-RELATED STANDARDIZATION

In addition to the military departments under DoD, various federal agencies related to, or cooperating with, DoD also issue standards and specifications containing EMC requirements. Among these are the following:

²⁻¹Schulz, R. B., Radiation Hazards Handbook, Revision 2, ECAC-HDBK-82-005, ECAC, Annapolis, MD, November 1982.

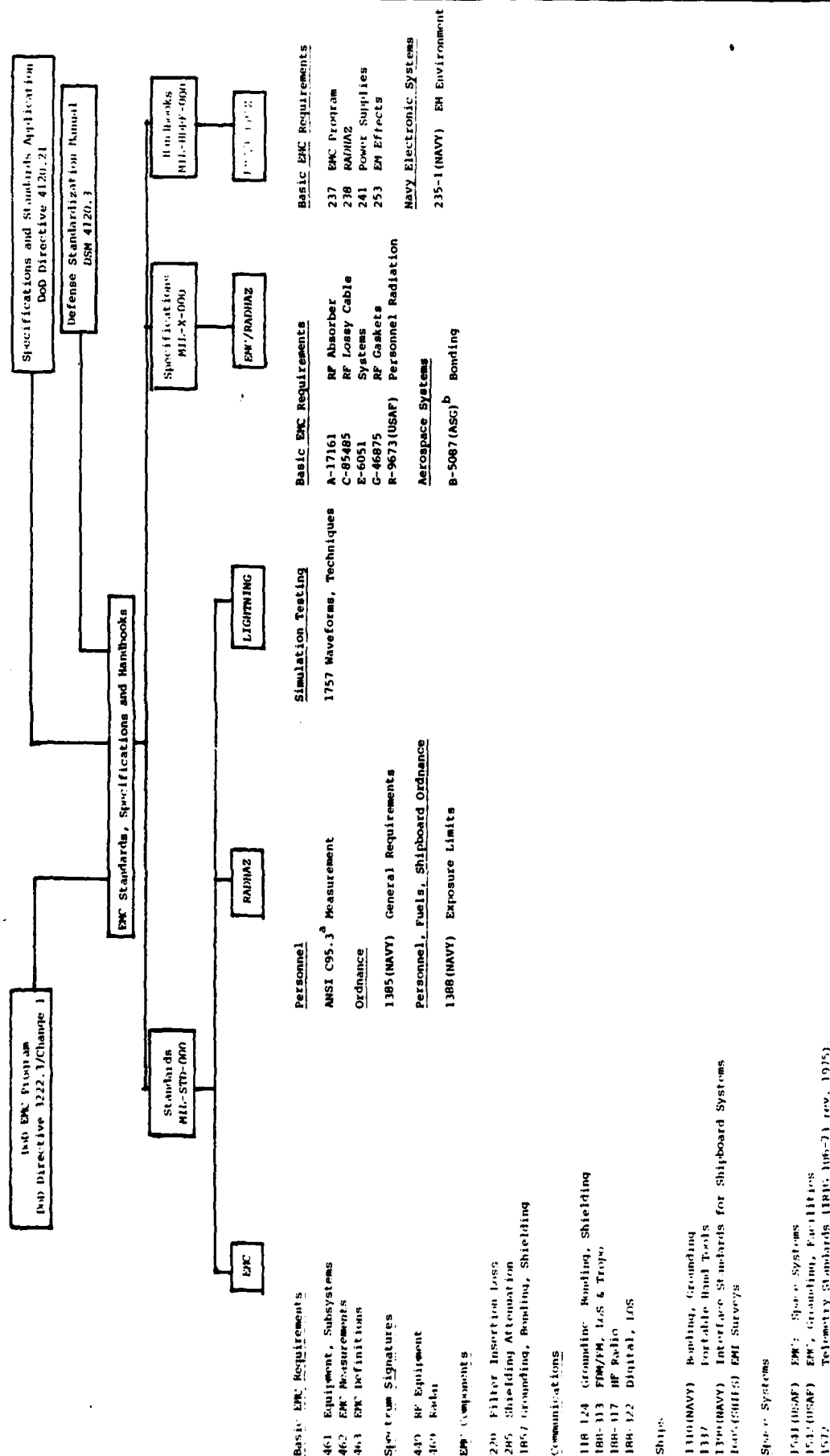


Figure 2-1. Organization chart of DoD directives and standards pertaining to EMC (revision letter omitted).

TABLE 2-1
DOD EMC, STANDARDS^a SPECIFICATIONS, AND HANDBOOKS
(Page 1 of 4)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-STD-220A 12/15/59 Method of Insertion Loss Measurement	Mandatory for Army, Navy, Air Force.	Covers a method of measuring in a 50-ohm system, the insertion loss of feed-through suppression capacitors, and of single- and multiple-circuit RP filters at frequencies up to 1,000 MHz.	Notice 1 Precautinary note for use in non 50- ohm systems.		MIL-STD-220
MIL-STD-285 8/25/76 Method of Attenuation Measurements for Enclosures, Electromagnetic Shielding for Electronic Test Purposes	Mandatory for Army, Navy, Air Force.	Covers a method of measuring the attenuation characteristics of electromagnetic shielding enclosures used for electronic test purposes over the frequency range 100 kHz to 10,000 MHz.		Plan is to adopt revised version of IEEE 299 (if acceptable to DoD) with possible additions/ modifications.	MIL-A-18123 (SHIPS)
MIL-STD-449D 2/22/73 Measurement of Radio Frequency Spectrum Characteristics	Mandatory for all DoD.	Establishes uniform measurement techniques to determine special characteristics of transmitters, receivers, antennas, and system couplers. Applies to all equipments, subsystems, and systems that are designed to emit or respond to EM energy from 0.014 MHz to 12 GHz, and wherever possible to 40 GHz.	Notice 1, 5/18/76 Contains corrections to published standard.	Formerly planned revisions are being held in abeyance.	MIL-STD-449C
MIL-STD-461B 4/1/80 Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference (Used with 462 and 463)	Mandatory for all DoD. To be applied for general or multi- service procurements and single- service procurement. (NAVELEX)	Ensures that interference control is considered and incorporated into the design of equipments and subsystems; and provides a basis for evaluating the electromagnetic characteristics of equipments and subsystems, as well as for inputs to analyses of the electromagnetic compatibility and effectiveness of systems in a complex electromagnetic environment.		FY82: Notice on "EMP Design Guidelines for Electronic Equipment". Also draft of "EMP Hardening Guidelines for Naval Ships".	MIL-I-6181 MIL-S-10379 MIL-S-12348 MIL-I-43121 MIL-E-55301(E) MIL-I-16910 MIL-I-17623 NPEC SPEC-50V MIL-STD-826A MIL-I-26600 MIL-STD-461A Notices 1-6
MIL-STD-462 7/31/67 Electromagnetic Interference Characteristics, Measurement of (Used with 461B and 463A)	Mandatory for all DoD.	Establishes techniques to be used for the measurement and determination of the EMC characteristics (emission and susceptibility) of electrical, electronic, and electromechanical equipment, as required by MIL-STD-461B.	Notice 1, 8/1/68 Corrections to standard. Notice 2, 5/1/70 Air Force procurements only. Notice 3, 2/9/71 Complete rewrite for Army.	Under revision, 462B (Letter A will be skipped) will be a revision and updating of test procedures in current standard.	Same list as MIL-STD-461B (except MIL-STD-461A)

^a AUTHOR. Some DoD standards contain different notices for different specific applications. Where notices appear, be certain to use the one that pertains to the application.

TABLE 2-1
(Page 2 of 4)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-STD-461A 6/1/77 Definitions and Systems of Units, Electromagnetic Interference Technology (Used with 461B, 462)	Mandatory for all DoD.	Contains general EMC definitions, abbreviations, and acronyms used in MIL-STD-461 () and MIL-STD- 462 (). They are limited to statements of meaning as related to these and referenced standards. Whenever possible, definitions also conform to those of ANSI, IEEE, SAE, NATO, etc.	Notice 1, 3/30/67 Corrections to standard. Notice 2, 2/25/75 Not applicable to Air Force.	469 Version A draft copy (due FY82) released and comments are being reviewed and collated. It will "Implement radar criteria published by NTIA." (See NOTE).	MIL-STD-463 Notice 1
MIL-STD-469 12/1/66 Radar Engineering Design Requirements, Electromagnetic Compatibility	Mandatory for all DoD except Air Force (NTIA RSE applies for Air Force).	Establishes engineering design criteria to control the spectral characteristics of all new radar systems operating between 100 and 40,000 MHz in an effort to achieve EMC and conserve the military spectrum. Measurement requirements included in appendix.			
NOTE: Part 5.3, "Radar Design Objectives and Engineering Criteria" of the National Telecommunications and Information Administration (NTIA) Manual of Regulations and Procedures for Radio Frequency Management contains guidance for all government agencies that are users of radar equipment, including the Department of Defense. The radar spectrum-engineering criteria currently consists of three application groups as follows: Group A: Pulsed radars of 1-MW or less rated peak power; or radars with an operating frequency above 40 GHz; or man-portable radars; or man-transportable radars; or radionavigation radars in the band 9300-9500 MHz as described above. Group B: Radars with a rated peak power of more than 1 MW, but not more than 100 kW, and operating between 2900 MHz and 40 GHz. Criteria B (para. 5.3.1.) effective for new radars on 10 October 1977. Group C: All radars not included in Groups A or B. Criteria C (para. 5.3.2) effective for new radars on 1 October 1977. Paragraph 2 of part 5.0 states that, in any instance of harmful interference involving the use of non-conforming equipment on one hand and the use of conforming equipment on the other hand, the responsibility for adjustment to eliminate the interference normally shall rest with the agency employing the non-conforming equipment, unless it is shown that the deficiency in that regard is not a contributing factor to the interference. (Reference: Assistant Secretary of Defense memo of 3 May 1973 on "Manual of Regulations and Procedures for Radio Frequency Management" promulgation by the Office of Telecommunications Policy (now NTIA), Executive Office of the President, January 1973). *New radars are those for which development and subsequent procurement contracts are let after 10 October 1977.					
MIL-STD-1310D (NAVY) 2/8/79 Shipboard Grounding and Bonding Other Techniques for Electromagnetic Compatibility and Safety	Approved for all interested commands of Navy.	Covers elements of ship design essential to attain shipboard EM by suppression of potential EMI sources, including intermodulation and reduction of susceptibility to electromagnetic pulse (EMP). Requirements cover design of ground systems, use of nonmetallic topside items, and installation, bonding, grounding, and shielding methods for equipment, cables, and conduct with associated safety features.		FY83.	MIL-STD-1310C (Navy)
MIL-STD-1317B (SHIPS) 4/8/73 General Suppression System Design Requirements for Portable Electric Hand Tools	Mandatory for Naval Ship Systems Command, (NSC)	Covers EMI design requirements for portable electric hand tools			MIL-STD-1317A (Ships)

TABLE 2-1
(Page 3 of 4)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-STD-1541 (USAF) 10/15/73 Electromagnetic Compatibility Requirements for Space Systems	Approved for Air Force.	Establishes EMC requirements for space systems, including launch vehicles, space vehicles, ground systems, and associated aerospace ground equipment (AGE). It does not apply to facilities that house such items.		Revision A due 1st Quarter FY80.	
MIL-STD-1542 (USAF) 4/15/74 Compatibility (EMC) and Grounding Requirements for Space System Facilities	Approved for Air Force.	Covers general EMC and grounding requirements for space-system ground facilities, including structures that house electrical/electronic devices or equipment such as service structures, tracking-station buildings, satellite control rooms, and spacecraft or booster assembly buildings, but not for Transport and Mail/Black data (see AF MAG-54, AF MAG-94 and the MAGSEC 5100 Series).			
MIL-STD-1605 (SHIPS) 4/20/73 Procedures for Conducting a Shipboard Electromagnetic Interference (EMI) Survey (Surface Ships)	Approved for the Naval Ship System Command.	Provides detailed procedures for conducting an EMI survey aboard surface ships. An EMI survey is required for new-construction ships and ships receiving overhauls or other major repair work that changes the electromagnetic configuration.		Draft due FY82.	Bureau of Ships Instruction 9671.25
MIL-STD-1757 6/17/80 Lightning Qualifica- tion Test Procedures for Aerospace Vehicles and Hardware	Approved for all DoD. (Air Force)	Presents standard test waveforms and techniques for lightning qualification testing of aerospace vehicles and hardware. Tests include high-voltage and high-current physical-damage tests. Indirect effects on electronic equipment are to be added later.			
MIL-STD-1857 6/30/76 Grounding, Bonding, and Shielding Design Practices	(Army)	Covers the characteristics of grounding, bonding and shielding design practices to be applied in the construction and installation of marine, fixed station, transportable, and ground-mobile electronic equipment, subsystems and systems.			
MIL-A-17161C 11/18/59 Absorber, Radio Frequency Radiation (Microwave Absorbing Material)	(Naval Electronic Systems Command)	Covers radio-frequency (RF) radiation absorber (microwave absorbing material) to be used for covering metal objects that reflect unwanted electromagnetic energy.			
MIL-B-5087B (ASG) 10/15/64 Bonding, Electrical, and Lightning Protection for Aerospace Systems	Approved for Air Force and the Naval Air Systems Command.	Covers characteristics, application, and testing of electrical bonding for aerospace systems, as well as bonding for the installation and interconnection of electrical and electronic equipment therein and lightning protection.	Amendment 2, 8/31/72 Additions and corrections to specifications.	FY83.	MIL-B-5087A (ASG) Amendment 1 to MIL-B-5087B (ASG)
MIL-C-85485 9/16/81 Cable, Electric, Filter Line, Radio Frequency Absorptive		Covers performance requirements for AF absorptive component wires, and finished cables which function electrically as distributed low-pass filters.			

TABLE 2-1
(Page 4 of 4)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-E-6051D 9/7/67 Electromagnetic Compatibility Requirements, System (Military Specification)	Mandatory for all DoD. Intended for use by Army for procurement of airborne systems and vehicles; Navy for associated subsystems and aircraft; Air Force for both aerospace and ground systems.	Outlines overall requirements for systems EMC, including control of the system EM environment, lightning protection, static electricity, bonding and grounding. It applies to complete systems, including all associated subsystems/equipment. It also covers critical categories, degradation criteria, interference and susceptibility control wiring, and cabling electrical power, personnel hazards, EM hazards to explosives and ordnance, suppression components.	Amendment 1, USAP, 7/5/68 States AF requirement for external grounds for servicing equipment.	FY83.	MIL-E-6051C
MIL-G-46875 12/14/73 Gasket, RFI Shielding	Approved for Army. (NI)	Covers requirements for an RFI gasket material formed of knitted wire mesh.			MIL-S-15735
MIL-HDBK-235-1A (Navy) 2/5/79 Electromagnetic (Radiated) Environment Considerations for Design and Procurement of Electrical and Electronic Equipment, Subsystems and Systems Part 1A	Provides information and guidance to Navy users. (NAVELEX)	Intent is to provide guidance and establish a uniform approach for the protection of Navy electronics from the adverse effects of the EM environment. Information provided on EM environments. Part I (U) - General Information. Part II (S); Part III (S); new Part IV (S). Describes EM levels that may be encountered from friendly and hostile emitters, respectively.		Draft due FY82, new tables.	MIL-HDBK-235-1 (Navy)
MIL-HDBK-237A 2/2/81 Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipment.	Guidance to managers of large programs. (NAVELEX)	This document is intended to provide managers responsible for the design, development, and acquisition of DoD platforms, systems, and equipment with the guidance necessary to establish an effective program for achieving the desired degree of EMC.			MIL-HDBK-237
MIL-HDBK-241A 4/1/81 Design Guide for Electromagnetic Interference Reduction in Power Supplies.	Approved for all DoD. (NAVELEX)	Offers guidance to power-supply designers in techniques that have been found effective in reducing conducted and radiated interference generated by power supplies.		FY83.	
MIL-HDBK-253 7/28/78 Guidance for the Design and Test of Systems Protected Against the Effects of Electromagnetic Energy	Approved for all DoD. (NAVELEX)	Provides program managers with guidance for the design and test of electronic systems that are to be immune to the detrimental effects of electromagnetic energy. Applies to aerospace and weapons systems and associated subsystems, to ordnance, and to support and checkout equipments for ordnance, aerospace, and weapons systems.			

TABLE 2-2
DOD RADHAZ STANDARDS, SPECIFICATIONS, AND HANDBOOKS
(Page 1 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
ANS C95.2-1966 (R1974) Radio-Frequency Radiation Hazard Warning Symbol	All DoD. (Adopted by DoD 6/28/67).	See TABLE 2-7.			
ANS C95.3-1976 (R1979) Techniques and Instrumentation for the Measurement of Potentially Hazardous Electromagnetic Radiation at Microwave Frequencies	All DoD. (Adopted by DoD 11/20/72).	See TABLE 2-7.			
ANS Z39.1-1980 American National Standard for the Safe Use of Lasers	Adopted by DoD 6/6/80.	See TABLE 2-7.			
MIL-STD-1377 (Navy) 8/20/71 Effectiveness of Cable, Connectors and Weapon Enclosure Shielding and Filters in Precluding Hazards of Electromagnetic Radiation to Ordnance, Measurement of	Mandatory for Navy. (NOS)	Provides shielding and filter-effectiveness test methods to determine if particular weapon-system design requirements of MIL-P-24014 have been properly implemented. Not a substitute for full-scale EM hazards evaluation tests but an aid in developing a weapon system with a high probability of passing such tests.			
MIL-STD-1385 (Navy) 4/6/72 Preclusion of Ordnance Hazards in Electromagnetic Fields, General Requirements for	Navy.	Establishes general requirements to preclude hazards resulting from ordnance with electro- explosive devices when exposed to electromagnetic fields. The nominal frequency range covered by this standard is from 10 kHz (10 ⁴ hertz) to 40 GHz (4 x 10 ¹⁰ Hertz).			MIL-P-24014 (MEP)

TABLE 2-2
(Page 2 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-STD-1388A 7/16/73 Electromagnetic Radiation Hazards to Personnel and Fuels Sections 408 Interface Standards for Shipboard Ordnance	Navy. (NSBC)	Specifies radiation exposure limits for micro-wave radiation, laser radiation, and ionizing radiation. Establishes interface requirements to prevent injury to personnel and accidental ignition of flammable volatile fuels on board ship as a result of EM radiation.			
MIL-STD-1399A (NAVY) Interface Standard for Shipboard Systems. 408, 7/16/73 Electromagnetic Radiation Hazards to Personnel and Fuels Center. Section 409, 8/31/73 Electromagnetic Radiation Hazards to Ordnance	Approved for Navy. (Navy 1 Ship Engineering Center)	Requirements and constraints on ship design and layout, and the installation of systems, in order to control EM radiation hazards on ships. Requirements between ship and shipboard ordnance containing EMP's to ensure compatibility of ordnance with the EM radiation environment.			
MIL-STD-1382-1 (NAVY) 8/10/73 Electromagnetic Radiation Hazards Notice 1 (1978)	Information and guidance to Navy users.	Addresses hazards due to EM radiation of the non-ionizing type. Intended for personnel concerned with the design, installation, and operation of electronic equipment capable of producing, or being susceptible to, EM radiation hazards.			

2-1 See also, Schulz, R. B., Radiation Hazards Handbook, Revision 2, 82-005, May 1982.

TABLE 2-3
DOD COMMUNICATIONS STANDARDS AND HANDBOOKS CONTAINING EMC PROVISIONS^a
(Page 1 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	EMC/RADHAZ Section	Topic	Superseded Documents
MIL-STD-188C 11/24/69 Military Communication System Technical Standards	Mandatory for all DoD. (USAE/OM)	Provides basic technical parameters of communications equipments and systems. (Note: Superseded for long-haul communications by MIL-STD-188-300 series; still valid for tactical communications.)	MultiChannel UNP 4.5.9.2.7.1.5.1 4.5.9.2.7.1.5.2 Microwave LOS 4.5.10.7.1.5.1 4.5.10.7.1.5.2	In-Band Noise. In-Channel Noise. In-Band Noise. In-Channel Noise.	MIL-STD-188H Notice 1
MIL-STD-188-124 6/14/78 Grounding, Bonding, and Shielding	Mandatory for all DoD. (RADC)	Minimum basic requirements and goals for grounding, bonding, and shielding of ground- based telecommunications C-S equipment installations, subsystems, and facilities, including buildings and structures supporting tactical and long-haul military communications systems.			
MIL-STD-188-310A 1/14/80 Subsystem Design and Engineering Standards for Technical Control Facilities	Mandatory for all DoD. (RADC)	Establishes criteria for engineering fixed Technical Control Facilities and associated Patch and Test Facilities in the Department of Defense.		EMC (MIL-STD-461).	MIL-STD-310
MIL-STD-188-313 12/19/73 Subsystem Design and Engineering Standards and Equipment Technical Design Standards for Long Haul Communications Transversing (Isic) Microwave LOS Radio and Tropospheric Scatter Radio	Mandatory for all DoD. (RADC)	Technical design standards for the performance of new FDM/FM subsystems and equipment in LOS and tropospheric-scatter radio transmission used in long-haul communications. LOS subsystems normally operate in the 4-13 GHz range; tropospheric in the 0.4-5 GHz range.	5.4.4.4. 5.5.3.4.4 5.6.2.5 5.6.3.2 5.6.7.3 5.11.3.1.1 5.11.3.1.3 20.3.1.3 20.3.2.4 20.4	Harmonic suppression. Spurious emission. Local-oscillator leakage. Equipment noise figure. Receiver noise figure. Antenna sidelobes. Front/back ratio. C/I of IF interface. C/I of IF interface. EMC engineering.	DOAC 330-175-1 (3.2.2.4- 3.2.2.4.9, 3.2. and 3.2.2.5.- 3.2.2.5.3.4)

^aNOTE: Be certain that attenuation requirements for buildings are not misapplied to equipment. Also note that antenna-terminal carrier-to-interference ratios are often not provided directly; requirements are frequently specific in terms of the receiver audio, video, or IF output.

TABLE 2-3
(Page 2 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	EMC/RADHAZ Section	Topic	Superseded Documents
MIL-STD-188-317 3/30/72 System Design and Engineering Standards and Equipment Technical Design Standards for High Frequency Radio	Mandatory for all DoD. (USACEEA)	Technical design standards (subsystems and equipment) for both design and installation of new and upgraded existing HF radio used in long-haul communications.	5.2.3.3 and 5.3.6. (Table I) 5.4.2.11 (Fig. 4, Table II) 5.4.3.7 5.4.3.8 5.4.3.9 5.4.3.16 5.4.3.17 5.4.5.7 10.3.4 10.4.4 10.6.4 10.8.4 10.9.3 20 (Table IV)	RF signal-to-noise ratios. Spurious emissions of ISB transmitters. ISB-receiver image-rejection. IF rejection. Intermodulation. LO radiation. Spurious. Transmitter balun IM. Secondary lobes -Rhombic. -Log periodic. -Y antenna. -Teg. -Billboard. Antenna Summary. Bit error rate. EMC (MIL-STD-461, MIL-STD-237). Digital quality. Digital service quality. Cochannel interference. EMI (MIL-STD-461/ 2/3).	DOAC 320-175-1 (3.2.2.2- 3.2.2.2-8 and 5.2.2- 5.2.2.9.2)
MIL-STD-188-322 11/1/76 Subsystem/Design/ Engineering and Equipment Technical Design Standards for Long-Haul Line- Sight (LOS) Digital Microwave Transmission	Mandatory for all DoD. (NAT)	Performance and design standards for new and (to the maximum extent possible) converted digital microwave radio links and equipment for long-haul line-of-sight (LOS) digital microwave transmission. Such systems normally operate in the 4.4-5.0, 7.125-8.4, and 14.4-15.4 GHz ranges.	4.3.1 4.5 5.3.6.5. (Table I) 5.4.1 5.9.4 5.12.1		
MIL-STD-411A 7/78 Vol. I Draft 4/79 Vol. II Draft Power and Environmental Control for Physical Plant		Provide technical guidance for government-owned long-haul communications (DCS) power and air conditioning facilities. Intended use includes the engineering design and installation of new power and air conditioning subsystems and equipment and upgrading of existing subsystems and equipment.			
MIL-STD-417 11/25/77 Facility Design for Tropospheric Scatter (Trans-horizon Microwave System Design)	Defense Communication System. (RADC)	Provides methods for transhorizon system design. Topics covered include: detailed path profiles, path-loss calculations, service-probability and fading-range estimates, radio-interference investigations, adherence to DCS noise standards and link equipment requirements. Graphs, basic equations, and tables are provided for optimizing the design through trade-off studies, and to ensure that the required functional, reliability, and safety requirements are met.	30 Pertinent paragraphs, e.g.: 4.2.15 4.2.29 4.4.39 4.5.8 4.5.15 5.6	Operating noise threshold, P _n . Potential radio interference. Radio-frequency interference. Types of interference. DCS noise requirements. Electromagnetic compatibility.	

TABLE 2-4
DOD MISCELLANEOUS STANDARDS AND SPECIFICATIONS CONTAINING EMC AND RADHAZ PROVISIONS
(Page 1 of 2)

Number/Date Title	Intended Use (Author)	Scope/Purpose	EMC/RADHAZ Section	Topic	Superseded Documents
MIL-STD-454F 3/15/78 Std. Gen'l Requirements for Electronic Equipment --- Notice 1, 6/30/79	Approved for all DoD.	This standard covers the common requirements to be used in military specifications for electronic equipment.	Requirement 61	Electromagnetic Interference Control (MIL-STD-461/2/3).	MIL-STD-454E
MIL-STD-7040 9/30/80 Aircraft Electric Power Characteristics	Approved for all DoD. (Naval Air Engineering Center)	Defines standards for aircraft electric power characteristics present at utilization equipment power-input terminals maintained during operation of the generation, distribution and utilization equipments, and systems applications aspects of utilization equipment.	5.2.1 5.2.2 5.3.1 5.3.3.1 5.3.3.2 5.3.4.1 5.3.4.2	AM sidebands. Voltage spike (MIL-F-6051).	MIL-STD-704A/B MIL-STD-704C superseded for new designs only; still valid for existing applications.
MIL-STD-1461(AR) 12/20/79 Evaluation of Munitions to Electromagnetic Fields. Require- ments for (C)	Approved for Army.	This document contains susceptibility limits for munitions in the form of curves of average and peak electric-field strengths vs. frequency for both transportation and tactical configurations.	4.5 4.6.2, Table II	Bonding and grounding. EMC (MIL-E-6051); >20dB safety margin. Shields. Shielding caps. Cables. Electrostatics. RF susceptibility. EM analysis environment. RF environment during transportation and handling (MIL-STD-461).	MIL-STD-833 (USAF)
MIL-STD-1512 3/21/72 Electro-explosive Subsystems, Electrically Initiated, Design Requirements and Test Methods --- Notice 1, 1/6/76	Mandatory for Air Force. (4950th Test Wing, WPAFB)	Establishes uniform design and qualification requirements and test methods for the design, development, and acceptance of all electro-explosive subsystems and component parts. --- Updated provisions	5.5 5.6 5.7 5.10.4 5.15.1.2 5.16, Table III 5.17.2 Table I 6.10 Method 205 Method 207 Method 303	RF sensitivity. EMI control plan. Static discharge sensitivity. RF sensitivity. EM analysis.	

TABLE 2-4
(Page 2 of 2)

Number/Date Title	Intended Use (Author)	Scope/Purpose	EMC/RADHAZ Section	Topic	Superseded Documents
MIL-STD-1572 5/17/76 Telemetry Standards (Adoption of IRIG 106-72, 11/75)	Approved for all DoD. (Range Commanders Council, White Sands Missile Range)	Guides the orderly implementation and application of telemetry systems for both the ranges and range users. The scope of capabilities attainable with utilization of these standards requires careful consideration of tradeoffs. Guidance concerning these tradeoffs is provided in the text.	2-1c 2-2a 2-2b	225-250 MHz Spurious emission, interference. Spurious response. Interference protection. 2200-2300 MHz Spurious emission, interference. Spurious emissions. Interference protection.	MIL-STD-4428
DoD-STD-1686 5/2/80 Electrostatic Dis- charge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	Approved for all DoD (NAVSEA).	Title self-explanatory. Covers only items sensitive up to 4 kV. See DoD-HDBK-263 for item sensitivity of 4-15 kV.	2-6c 2-7a 2-7b		
MIL-STD-1695 9/13/77 Environments, Working, Minimum Standards for MIL-R-9673B 4/4/60 Amend. 2, 9/15/01 Radiation, Limits, Microwave and X- Radiation Generated by Ground Electronics Equipment	Approved for Navy; available for use by DoD. Air Force.	Defines minimum standards for working environments applicable to suppliers of military hardware.	30.4, Table A-VIII 40, Ref. 13	Static electricity.	

Defense Nuclear Agency
National Security Agency
Defense Communications Agency
Joint Tactical Communications (TRI-TAC) Office
Defense Medical Materiel Board.

Also cooperating with the U.S. DoD in many areas are two agencies of the Canadian Department of National Defence:

Section Head (DEMPS 4), Directorate of Engineering and
Maintenance Planning and Standardization
Canadian Military Electronic Standards Agency.

Internationally, the North Atlantic Treaty Organization (NATO) issues EMC standards, which are listed in TABLE 2-5.

FEDERAL AGENCIES ISSUING EMC-RELATED STANDARDS/REGULATIONS

Standards and regulations that may contain EMC requirements are issued by various agencies of the federal civil government such as those listed below.

Agriculture (USDA)

Forest Service
Soil Conservation Service

Commerce (DOC)

National Marine Fisheries Services
National Telecommunications and Information Administration (NTIA)

Consumer Product Safety Commission (CPSC)

Environmental Protection Agency (EPA)

Energy Research and Development Administration (ERDA)

TABLE 2-5
NATO STANAG's^a ON EMC STANDARDS, SPECIFICATIONS, AND HANDBOOKS

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MAT-STD-2345 12/16/79 Control and Recording of Personnel Exposure to Radio-Frequency Radiation					
MAT-STD-3456 (Ed. 4) Aircraft Electrical System Characteristics	MIL-STD-704D.	See MIL-STD-704D in TABLE 2-4.	<u>Amendments 1, 2</u>		
MAT-STD-3516 11/21/77 Electromagnetic Compatibility for Aircraft Electrical and Electronic Equipment	MIL-STD-461, 462.	The minimum requirement and essential test methods pertaining to intra-system Electro-magnetic Compatibility of electrical and electronic equipment including Ground support Equipment for use with aircraft systems.	<u>Amendments 1,2</u>		
MAT-STD-3614 1/26/76 Electromagnetic Compatibility (EMC) of Aircraft Systems	MIL-E-6051D.	The minimum requirements for limits of permissible mutual electromagnetic emissions, susceptibility, and transient levels to assure compatibility of electrical and electronic systems, as installed on aircraft, and measuring procedures to ascertain compliance therewith.	Notice 1, 5/15/77 EMC of Aircraft Systems		
MAT-STD-3659 2/24/75 Bonding and In-flight Lightning Protection for Aircraft	Amendments 1, 2	Establish minimum bonding and in-flight lightning protection requirements for aircraft associated tests.			
MAT-STD-4006 3/8/65 Shielded Sparking tactical Plugs (for 5 mm Lead) for Wheeled Tactical Vehicles (Pt 1) and Shielded Ignition Cables for Wheeled Tactical Vehicles (Pt 2)		Standardizes, for the use of the NATO Armed Forces, certain dimensions of shielded plugs (for 5-mm leads) for wheeled vehicles.			

^a STANAG: Standard Agreement.

General Services Administration (GSA)

Government Printing Office (GPO)

Tests and Technical Control

Health & Human Services (HHS)

Food and Drug Administration (FDA)

Health Services Administration

National Institutes of Health (NIH)

Housing and Urban Development (HUD)

Office of Technical and Credit Standards

Interior

Bonneville Power Administration

Bureau of Mines

Geological Survey

Justice

Federal Prisons Industries

Labor

Occupational Safety and Health Administration (OSHA)

National Aeronautics and Space Administration (NASA)

Kennedy Space Center

Lewis Research Center

Marshall Space Flight Center

Postal Service (USPS)

Office of Procurement

Tennessee Valley Authority (TVA)

Safety Staff

Department of Transportation (DOT)
Aeronautical Center Oklahoma
Airways Facilities Service
Federal Aviation Administration (FAA)
Federal Highway Administration (FHA)
Federal Railroad Administration (FRA)
Systems R&D Service

Treasury

Bureau of Alcohol, Tobacco, and Firearms

Veterans Administration (VA)

Department of Medicine and Surgery

Standards and regulations issued by non-DoD Federal agencies are listed in TABLE 2-6.

VOLUNTARY EMC/RADHAZ STANDARDIZATION

There are many national, voluntary, nongovernment standards organizations that play an important role in EMC. The more prominent ones are discussed in the following paragraphs.

American National Standards Institute (ANSI)

ANSI is a federation of industrial, trade, technical, labor, and professional organizations, government agencies, and consumer groups. The principal functions of ANSI are to coordinate the development of voluntary standards in the private sector and to provide national representation to international standardization organizations. Many ANSI standards in the areas of computers, data transmission, and information processing have been adopted by the federal government.

TABLE 2-6
FEDERAL STANDARDS AND REGULATIONS
(Page 1 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
FED-STD-1033 (Proposed) (NTIA) Digital Communication Performance Parameters		COMMERCIAL National Telecommunications and Information Administration (NTIA) Vol. 1 - Technical considerations Vol. 2 - Three examples			
Manual of Regulations and Procedures for Federal Radio Frequency Management	All federal agencies. (NTIA)	Scope is illustrated by chapter headings: 1. Authority and Organization. 2. Telecommunications Policy. 3. International Matters. 4. Allocations, Allotments, and Plans. 5. Technical Standards, Requirements, and Objectives. 6. Definitions and Particulars of Assignments. 7. Authorized Frequency Usage. 8. Procedures and Principles for the Assignment and Coordination of Frequencies. 9. Preparation of Applications for Frequency Assignment Action. 10. Processing of Applications for Frequency Assignment Action. Appendices A-I and Index.		Under continual revision	Manual by NTIA supersedes one by OGP.
EPA-520/7-73-001, 8/73, Non-Ionizing Radiation Measure- ment Capabilities -- State and Federal Agencies	Federal and State Agencies.	ENVIRONMENTAL PROTECTION AGENCY (EPA) Capabilities of various state organizations and Federal Agencies to measure nonionizing EM radiation have been determined. This document is intended to aid agencies of the Federal Government in locating possible sources of measurement assistance. The data collected in this study is used to determine the response characteristics of a microwave scanning spectrum analyzer, in the presence of a relatively intense and complex electromagnetic environment, and arrive at conclusions as to what can be used to facilitate future measurements.			
EPA-520/1-74-005 5/74, RF Pulse Spectral Measure- ments in the Vicinity of Several Air-Traffic-Control Radar		FEDERAL COMMUNICATIONS COMMISSION (FCC) Requirements, technical specifications, and equipment authorization procedures for an incidental and restricted radiation device, which apply to the marketing of such a device, are set forth.			
FCC-15				Details being added on: 1) security and alarm devices, 2) data processing equipment, and 3) switching power supplies. Section 18 is undergoing a complete rewrite, basically to follow CISPR Recommendations.	
FCC-18					

TABLE 2-6

(Page 2 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MMS-201-0004 10/1/79 Electromagnetic Compatibility Standard for Medical Devices	Conformance voluntary; not required. (FDA)	<u>HEALTH & HUMAN SERVICES (HHS)</u> <u>Food and Drug Administration (FDA)</u> Requirements on emissions and susceptibility of medical devices. Test methods provided. Rationales given (APPENDIX A). Does not address signal-line or patient-lead conducted emissions and susceptibility. <u>LABOR</u> <u>Occupational Safety and Health Administration</u> <u>TRANSPORTATION</u> <u>Federal Aviation Administration (FAA)</u> This National Standard is a description of the characteristics of the DMS in terms of signals and formats handled and processed by all users. This engineering requirement/specification estab- lishes the minimum requirements for grounding, bonding, & shielding of radar, navigation, data processing, meteorological, and communication equipments to include radio, satellite terminals, telephone central offices, and microwave links, & other electronic equipments in support of air-traffic-control functions. Establishes the minimum requirements for ground- ing, bonding, and shielding of fixed, mobile, and transportable radar, navigation, and communica- tion and communications facilities including those buildings and structures required for Flight Service Stations, Air Traffic Control Towers, and Air Route Traffic Control Centers.			
29 CFR 1910.97					
FAA-DMS 3/27/78 Proposed U.S. National Aviation Standard for the Discrete Address Beacon System (DMS)					
FAA-ER-350-023 Electronic Equip- ments Grounding, Bonding and Shielding Practices General Requirements					
FAA-ER-350-024 7/31/73 Buildings and Structures Ground- ing, Bonding, and Shielding Practices General Requirements					
FAA 6.050.17A 4/10/69 Handbook Frequency Management Engineering Principles					

Computer and Business Equipment Manufacturers Association (CBEMA)

The CBEMA is an association of approximately 41 manufacturers of office machines, equipment, furniture, and supplies. The Association holds conferences and seminars in management and distribution and conducts market research. The CBEMA also cooperates in developing standards in the U.S. and abroad for computers, data-processing equipment, and office machines. One of its committees is Telecommunications.

Electronic Industries Association (EIA)

The EIA is a nonprofit organization representing manufacturers of electronic products. The activities of EIA include the development of voluntary standards for electronic components, circuits, and equipment. Standardization activities of EIA are coordinated with ANSI and other organizations. Some of these activities, such as standardization in the area of digital interface circuits, directly impact government standards.

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE is a professional organization, and one of its activities is the development of voluntary standards in the area of communications-electronics with emphasis on measurement techniques and definitions of terms. Several IEEE standards have been used as a basis for developing communications standards in the MIL-STD-188 series of documents.

Instrument Society of America (ISA)

The ISA is a scientific, technical, and educational organization dedicated to advancing the knowledge and practice related to the theory, design, manufacture, and use of instruments and controls in science and industry. It conducts conferences and symposia, develops standards, publishes and disseminates information, provides educational services, and recognizes individual achievement.

National Electrical Manufacturers Association (NEMA)

NEMA is composed of manufacturers of equipment and apparatus used for the generation, transmission, distribution, and utilization of electric power, such as electrical machinery, motors, transportation, communication, and lighting equipment. It develops product standards covering such matters as nomenclature, ratings, performance, testing and dimensions; participates in developing National Electrical Code and National Electrical Safety Codes; and advocates their acceptance by state and local authorities. One of its divisions is Electronics.

Radio Technical Commission for Aeronautics (RTCA)

RTCA is an association of aeronautical organizations of the United States from both government and industry. Dedicated to the advancement of aeronautics, RTCA seeks sound technical solutions to problems involving the application of electronics and telecommunications to aeronautical operations. Its objective is the resolution of such problems by mutual agreement of its member organizations. The findings of RTCA are in the nature of recommendations to all organizations concerned.

Scientific Apparatus Makers Association (SAMA)

SAMA standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining without delay the proper product for his particular need.

SAE (formerly Society of Automotive Engineers)

The SAE is a professional society of engineers in fields of self-propelled ground, flight, and space vehicles. Its objective is to promote design, construction, and utilization of self-propelled mechanisms, prime

movers, components thereof, and related equipment. One of its publications is an annual handbook on standards. Committees include Aerospace Electronics (AE-4) and Automotive Electronic Systems (C-95).

Voluntary (non-government) standards of these primarily-U.S. organizations are listed in TABLE 2-7.

RADIO SERVICES AND APPLICABLE STANDARDS/REGULATIONS

Project engineers are often asked to perform an EMC analysis that involves not only military equipment but the equipment in a civilian environment. A typical example of such a project would be the introduction of a military radar into a civil airport or into a populated area. To perform such an analysis, the project engineer must determine the electrical characteristics of both the military radar and the civilian environment. The following tabulation of non-DoD documentation is provided to assist the analyst in determining the characteristics of equipment in the civilian environment additional to those in the ECAC data base.

Communications

Aeronautical Communications

VHF/UHF Air/Ground Communications Frequency Engineering Handbook,
Federal Aviation Administration (FAA) Handbook 6050.4A.

Manual of Regulations and Procedures for Radio Frequency Management,
National Telecommunications and Information Administration (NTIA), continually updated.

Aeronautical Communications, Annex 10, International Civil Aviation
Organization (ICAO), latest revision.

TABLE 2-7
U.S. VOLUNTARY EMC/RADHAZ STANDARDS
(Page 1 of 11)

Number-Date ^a Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
ANS C16.39-1972 Specifications for Electromagnetic Noise and Field Strength Instrumentation, 10 kHz to 1 GHz	IEEE 184-1969	Defines the requirements of EM-noise instrumentation for the frequency range of 10 kHz to 1000 MHz incorporating quasi-peak, peak, rms, and average detectors. Includes a frequency-selective voltmeter with appropriate coupling devices (antennas and current probes).		Under revision to extended frequency range both up and down.	CS3.2-1963 CS3.3-1963
ANS C63.4-1981 Methods of Measurement of Radio-Noise Emissions from Low- Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz.		Sets forth uniform methods of measurement of radio noise emitted from low-voltage electrical and electronic equipment in the frequency range of 10 kHz to 1 GHz. Methods for the measurement of radiated and powerline conducted radio noise are covered and apply to the measurement of individual components, units, or systems.		As above.	ANSI CS3.4-1963 R1978
ANS C63.12 (Draft 7/20/79) Recommended Practice on Procedures for Control of System Electromagnetic Compatibility		(1) Discusses the general properties of environmental radio noise of both man-made and natural origin. (2) Identifies appropriate measurement devices. (3) Discusses the rationale that can be used in selecting a consistent set of limits. (4) Provides a suggested set of limits for general application.			
ANS C95.1-1974 ^c Electromagnetic Radiation with Respect to Personnel, Safety Level of		Recommendations are made to prevent possible harmful effects on mankind, resulting from exposure to EM radiation from 10 MHz to 100 GHz. They are not intended to apply to the deliberate exposure of patients by, or under the direction of, practitioners of the healing arts.		Revised draft due 6/80.	
ANS C95.2-1966 (R1974) Radio-Frequency Radiation Hazard Warning Symbol	Adopted by DoD, 6/28/67.	Applies to design of a symbol for use as a sign intended to warn workers or the public of the presence of biologically hazardous levels of electromagnetic radiation and, insofar as considered desirable, to define specific hazards and provide cautionary information.		Under revision.	
ANS C95.3-1973 (R1979) Potentially Hazardous Electromagnetic Radiation at Microwave Frequencies, Techniques and Instrumentation for the Measurement of	Adopted by DoD 11/20/72.	Establishes as specifications for techniques and instrumentation to be used in evaluating radio-frequency hazards to personnel. Emphasis is on techniques for measuring power density at microwave frequencies and are generally applicable only in the far field.	Standard will be extended to measure quantities associated with hazards to personnel and ordnance.		

^a(1982). Redefined 1982.
^bANSI C16.39-1972 is identical to other standards organizations (here, primarily IEEE) are listed under the originating organization.
^cSee APPENDIX B, TABLE B-2, for proposed levels.

Note: ANSI C95.1-1962 has been issued but not yet been received for inclusion here.

TABLE 2-7
(Page 2 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
AMS C95.4-1981 Safety Guide for the Prevention of Radio Frequency Hazards to Electric Blasting Caps AMS C112.1-1973 Electromagnetic Radiation from Motor Vehicles (20-100 MHz), Measurement of AMS Z136.1-1980 American National Standard for the Safe Use of Lasers	IME Pub. 20 Adopted by DoD 6/6/80	See Institute of Makers of Explosives, Publication 20. Provides reasonable and accurate guidance for the safe use of lasers and laser systems with with output wavelengths between 0.2 μ m and 1mm. <u>COMPUTER AND BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION (CBEMA)</u> Intended to suggest a general methodology for establishing emission limits from electrical/ electronic equipment and to present the results of specific application of this methodology to EDP/OE products. (Although not a standard, this report contains recommendations for limits and methods of measurement.) <u>ELECTRONIC INDUSTRIES ASSOCIATION (EIA)</u> ^b Details definitions and methods for measurement of the characteristics of FM or PM Land Mobile Transmitters in fixed or vehicular installations. Intended to promote compatibility of these transmitters with systems in which they operate. Describes label to be affixed to receivers in accordance with FCC Part 15. Details definitions and methods of measurement of characteristics of FM or PM Land-Mobile Receivers in fixed vehicular installations.			
CHDMA/ESCS 5/20/77 Limits and Methods of Measurement of Electromagnetic Emissions from Electronic Data Processing and Office Equipment RS 1528 2/70 Land-Mobile Communications, FM or PM Transmitters, 25-470 MHz RS 163 8/56 MF Radiation Label RS 204B, 4/80 Minimum Standards for Land-Mobile Communication FM or PM Receivers, 25-470 MHz.	Being considered for revision to FCC Part 15. FCC Part 15.				

^bRS: Recommended standard.
TK: Technical report.

TABLE 2-7
(Page 3 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MS 316B, 5/79 Minimum Standard for Portable/Personal Radio Transmitters, Receivers, and Transmitter/Receiver Combination Land- Mobile Communications PM or FM Equipment, 25-1000 MHz		Details minimum performance requirements for FM or PM portable/personal radio transmitters, receivers, or combinations of both which can be hand-carried or worn on the person, and which are operated from their own portable power source and antenna.			
MS 361 1/69, 12/74 Feed-Through Radio Interference Capacitors-Paper, Film and Paper/Film Dielectric	ANSI C83.54 1969, 1975.	Covers general requirements for ac and dc paper, film and paper-film dielectric and feed-through capacitors for both foil and metal types, hermetically sealed in metal cases, used primarily in broadband RI suppression.			
RS 378, 8/70 Measurement of Spurious Radiation from FM and TV Broadcast Receivers in the Frequency Range of 100 to 1000 MHz, Using the EIA-Lautel Broadcast Band Antenna		Describes the potential sources of spurious radiation from FM and TV broadcast receivers and sets up methods of measurement whereby the strength of some of these radiations may be determined.			
RS-388 1/71 Minimum Standard for Test Conditions Common to PM or PM Land-Mobile Communications Equipment 25-470 MHz		Details common test conditions under which performance parameters of PM or PM Land-Mobile communication transmitters, receivers, control and selective signalling units, power supplies, station combinations, mobile combinations, personal, portable, or other assemblies of equipment, including complete operating packages, shall be measured. Methods of measuring the test conditions are also included.			
RS 416, 3/74 Filters, Radio Interference	ANSI C83.102 1974.	Covers the general requirements for current-carrying filters, ac and dc, for use primarily in the reduction of broadband radio interference.			
RS 450, 9/78 Standard Form for Reporting Measurements of Land Mobile, Base Station and Portable/ Personal Radio Receivers in Compliance with FCC Part 15 Rules	FCC Part 15.	Standard reporting form suggested by FCC. Provides uniform method of making and reporting the summary of measurements outlined in title. Form supplements Part 15 Rules and must be used in conjunction with them.			
TH 8.10 Ignition Interference Susceptibility- Measurement Correlation					

TABLE 2-7
(Page 4 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
<p>TS 8-12 Automotive Electronic Equipment Other Than Receivers and Transmitters</p> <p>EIA EMC 3-1968 Testing and Measurement Techniques For Electronic Equipment (part of Designer's Guide on EMC, 1968)</p> <p>EIA Industrial Electronics Bulletin No. 10C- 1973 Interference Criteria for Microwave Systems in the Safety and Special Radio Services</p>		<p>Provides a set of interference matrices and supporting text with a set of interference criteria for four microwave bands.</p> <p>INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)</p> <p>Contains EMC-related definitions.</p>		<p>Revision underway.</p> <p>Revision underway.</p>	<p>Bul. 10-A</p>
<p>IEEE 100-1977 IEEE Standard Dictionary of Electronic and Electrical Terms</p> <p>IEEE 139-1970 Recommended Practice for Measurement of Field Intensity Above 300 MHz from Radio Frequency Industrial, Scientific, and Medical Equipments</p> <p>IEEE 140-1950 Recommended Practice for Minimization of Interference from Radio Frequency Heating Equipment</p> <p>IEEE 184-1969 Test Procedure for Frequency- Modulated Mobile Communications Receiver</p>	<p>ANS C16.39-1972</p>	<p>Provides information on methods of measurement, antenna design, and equipment for making field- strength measurements above 300 MHz.</p> <p>Recommends the formulation of good engineering practices where interference is encountered. Reviews the theoretical aspects of the interference problem, and outlines procedures which should be followed.</p> <p>Covers definitions of terms, controlled test conditions, test apparatus, test methods, and data presentation that form the basis for establishing performance criteria of FM mobile communications receivers from 25 to 1000 MHz. Specific limits are not included; however, reference values that are not limited by the state-of-the-art are provided.</p>			

TABLE 2-7
(Page 5 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEEE 185-1975 Frequency-Modulated Broadcast Receivers, Standard Methods of Testing	ANSI/IEEE INF-T-200	Covers definitions of terms and methods of testing receivers designed to receive FM broadcast transmissions of 88 to 108 MHz.			
IEEE 186-1948 (R 1972) Amplitude-Modulation Broadcast Receivers, Standard Methods of Testing					
IEEE 187-1951 Spurious Radiation from Frequency- Modulation and Television Broadcast Receivers, Open-Field Method of Measurement of		Describes the potential sources of spurious radiation from FM and broadcast receivers and sets up methods of measurement whereby the strength of some of these radiations may be determined.			None
ANSI/IEEE 213-1961 (R 1974) Radio Interference: Methods of Measurement of Conducted Interference Output to the Power Line from FM and Television Broadcast Receivers in the Range 300 kHz to 25 MHz	ANSI/IEEE 214.	Defines a method for obtaining a measure of the interference conducted by the power line from the various interference sources in FM and TV broadcast receivers, 300 kHz to 25 MHz.		1982	54 IRE 17 a1 56 IRE 27 a1 58 IRE 27 a1
ANSI/IEEE 214-1961 Construction Drawings of Line Impedance Network Required for Measurement of Conducted Interference to the Power Line from FM and Television Broadcast Receivers in the Range of 300 kHz to 25 MHz as Specified in IEEE 213-1961	ANSI/IEEE 213.	(See title)		1982	
IEEE 263-1965 Radio Noise Generated by Motor Vehicles and Affecting Mobile Communications Receivers in the Frequency Range 25 to 1000 MHz, Standard for Measurement of		Provides a uniform method of measurement of radio noise generated by a motor vehicle, which may affect the performance of mobile communications receivers in the vehicle.		Under review.	

TABLE 2-7
(Page 6 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEEE 284-1969 State-of-the-Art of Measuring Field Strength, Continuous Wave, Sinusoidal, Standards Report of the		Reports on the state-of-the-art of measuring RF field strength with respect to available and desirable accuracies, general principles of measurement techniques, and calibration methods, and references to pertinent literature.			
IEEE 291-1969 Measuring Field Strength in Radio Wave Propagation, Standards Report on		Report on the state-of-the-art of measuring the noise temperature of noise generators, pertains only to thermal, gas-discharge, and shot-noise generators with a single output port and does not deal with noise factor, effective input noise temperature, or any other figure of merit of noise performance of transducers or systems.			
IEEE 294-1969 Measuring Noise Temperature of Noise Generators		Provides uniform test procedures and estimation techniques to determine the relative effectiveness of room-size, high-performance shielding enclosures.		(New revision is being prepared, to be coordinated with revised MIL-STD-285.)	
IEEE 299-1969 Recommended Practice for Measurement of Shielding Effectiveness, High-Performance Shielding Enclosures					
IEEE 302-1969 Electromagnetic Field Strength for Frequencies Below 1000 MHz in Radio Wave Propagation, Standard Methods for Measuring					
ANSI/IEEE 368-1977 Recommended Practice for Measurement of Electrical Noise and Harmonic Filter Performance of High-Voltage Direct-Current Systems		Establishes uniform methods of measuring the performance of harmonic filters and of testing for the presence of noise on, and in the proximity to, HVdc transmission systems and their associated ac systems. Applies to induced noise effects to wire communication systems; that is, telephone, data transmission, and railroad signaling systems; for the voice band 120-5000 Hz and carrier band 5-100 kHz and above. Excludes RFI effects (300 kHz and above) from HV converter stations and HVdc transmission lines.			
ANSI/IEEE 376-1975 IEEE Standard for the Measurement of Impulse Strength and Impulse Bandwidth		Establishes definitions and provides test procedures for the measurement of impulse strength and impulse bandwidth.		1980	
IEEE 177-1980 IEEE Recommended Practice for Measurement of Spurious Emission from Land-Mobile Communi- cation Transmitters		Recommends procedures for measuring broadband and narrowband spectra, both conducted and radiated, of FM signals from 25-1000 MHz.			

TABLE 2-7

(Page 7 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
ANSI/IEEE 430-1976 Standard Procedures for the Measurement of Radio Noise from Overhead Power Lines		Establishes uniform procedures for the measurement of radiation of radio noise from overhead powerlines with meters that conform to ANSI standards, over the frequency range 0.015-30 MHz. Offers guidance for the range 20-1000 MHz.			
IEEE 469-1977 Voice Frequency Electrical Noise Tests of Distribu- tion Transformers, Required Practice for		Standard methods of testing distribution trans- formers, to determine their voice frequency noise contribution to paralleling communications circuits, are provided for use by transformer manufacturers, users, and others in industry in evaluating the design choices available.			
IEEE 521-1976 Letter Designations for Radar-Frequency Bands		Defines the letter-band nomenclature to be used as a convenience for describing the frequency in which radar operates. These letters are not substitutes for the specific frequency limits of a radar.		ANSI/IEEE 539a-1981	
ANSI/IEEE 539-1979 Overhead Power Line Corona and Radio Noise, Definitions of Terms Relating to					
IEEE 644-1979 11/16/79 IEEE Recommended Practices for Measurement of Electric and Magnetic Fields for AC Power Lines		Establishes uniform procedures for the measurement of steady-state electric and magnetic fields (near fields close to ground level) from alternating current overhead power lines and for calibration of the meters used in these measurements. They can also be tentatively applied to electric-field measurements near an energized conductor or structure with limitations as outlined.			
IME Pub. 20-1981 Safety Guide for the Prevention of Radio Frequency Radiation Hazards	Adopted by ANSI as ANSI C95.4	<u>INSTITUTE OF MAKERS OF EXPLOSIVES</u> Provides basis for assessing hazards associated with initiation of commercial electric blasting caps by RF energy by indicating safe separation distances.			
MEMA M02-1970 Solid-State Lamp Dimmers		<u>NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)</u>			
MEMA 107-1964 Radio Influence Voltage of HV Apparatus, Measurement Methods					
NFPA 77-1972 Static Electricity, Recommended Practice on		<u>NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)</u>			
NFPA 78-1968 Lighting Protection Code					

TABLE 2-7

(Page 8 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
DO160A-1980 Environmental Conditions and Test Procedures for Airborne Equipment	EUROCAE and ISO, C	<u>RADIO TECHNICAL COMMISSION FOR AERONAUTICS (RTCA)</u> Sets forth a series of standard environmental test conditions (categories) and applicable test pro- cedures for airborne equipment. The purpose of these tests is to provide a laboratory means of determining the performance characteristics of the equipment under environmental conditions represen- tative of those which may be encountered in operation of the equipment.			DO-108 DO-138 DO-160
DO168-1979 Minimum Performance Standards - Emergency Locator Transmitters					
DO176-1982 FM Broadcast Interference Related to Airborne ILS, VOR and VHF Communications		<u>SNE (FORMERLY SOCIETY OF AUTOMOTIVE ENGINEERS)^d</u>			
AIR 1147 EMI on Aircraft from Jet Engine Charging					
AIR 1208 Bibliography - Lightning and Precipitation Static					
AIR 1209 Construction and Calibration of Parallel Plate Transmission Line for Electromagnetic Susceptibility Testing		Provides information relating to the construction, calibration and usage of parallel-plate transmission lines in EMC susceptibility testing.			
AIR 1221-1971 Electromagnetic Compatibility (EMC) System Design checklist		Checklist to be used by project personnel to assure that factors required for adequate system EMC are considered and incorporated into a program.			
AIR 1455 Spectrum Analyzers for EMI Measurements					

EUROCAE: European Organization for Civil Aviation Electronics.

ISO: International Standards Organization.

AIR: Aerospace Information Report.

AMP: Aerospace Recommended Practice.

TABLE 2-7

(Page 9 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
AIR 1394 Cabling Guidelines for Electromagnetic Compatibility					
AIR 1404 DC Resistivity vs. RF Impedance of EMI Gaskets					
AIR 1406 Lightning Protection and Static Electrification					
AIR 1423 EMC on Gas Turbine Engines for Aircraft Propulsion					
AIR 1425 Methods of Achieving EMC on Gas Turbine Engines for Self-Propelled Land Vehicles					
AIR 1500 Bibliography-Loosey Filters.					
AIR 1509 (Draft) EMC Antennas and Antenna Factors: How to Use Them					
ARP 935-1970 Suggested EMI Control Plan Outline					
ARP 936 Capacitor, 10 MFD for EMI Measurements					
ARP 937 Jet Engine Ignition Interference					
ARP 958 3/1/68 Broadband Electro- magnetic Interference Measurement Antennas; Standard Calibration Requirements and Methods	MIL-STD-826, MIL-STD-461, MIL-STD-462.	Discusses use and application of EMC antennas and antenna factors. Relationships among antenna gain, antenna factor, power density (W/m ²), and field strength (V/m) are discussed. Includes a brief discussion covering the scope of the EMI control program with respect to contractual EMC requirements. Outlines a standard method and technique for the checkout and calibration of broadband electro- magnetic interference measurement antennas. Covers conical logarithmic spiral antennas identified by the following USAF drawing numbers: 82J6040 200 to 1000 MHz 82J6041 1 to 10 GHz			None

TABLE 2-7
(Page 10 of 11)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
ARP 1172 Filters, Conventional Electromagnetic Interference Reduction, General Specification for					
ARP 1173 Test Procedure to Measure the RF Shielding Characteristics of EMI gaskets		Establishes a testing technique for measuring the RF shielding characteristics of shielding gasket materials, and establishes standard terminology and references.			
ARP 1267-1973 Electromagnetic Interference Impulse Generators; Standard Calibration Require- ment and Techniques					
ARP 1285 Test Procedures for Measuring Shielding Effectiveness of Electrical Connectors and Associated Hardware		Establishes procedure to measure the shielding effectiveness of multiple electrical connectors against external electromagnetic interference.			
ARP 1705 6/1/81 Coaxial Test Procedure to Measure the RF Shielding Characteristics of EMI Gasket Materials		Establishes a technique using conducted methods for reliably and repeatedly measuring RF shielding characteristics of EMI gasket materials and to establish standard terminology.			
J551q - 1980 Measurement of Electromagnetic Radiation from Motor Vehicles (20 - 1000 MHz)	Referenced in MIL-STD-461B.	Provides test procedures and recommended levels to assist engineers in the measurement of impulsive electromagnetic radiation over the frequency range of 20-1000 MHz from a motor vehicle or other device powered by an internal combustion engine (excluding aircraft).			J551a- J551f
J1113a 6/78 Electromagnetic Susceptibility Test Procedures for Vehicle Components (except aircraft)		Establishes uniform laboratory techniques for the measurement and determination of the susceptibility to undesired EM sources of electrical and electromechanical ground- vehicle components.		New revision is being prepared.	J1113
J1138 6/81 Open-Field Whole-Vehicle Radiated Susceptibility 10 KHz to 18 GHz, Electric Field					

TABLE 2-7
(Page 11 of 11)

Number/Date Title	Intended Use (Author)	Scope/Purpose	EMC/RADHAZ Section	Topic	Superseded Documents
<p>PMC 33.1 - 1978 Electromagnetic Compatibility of Process Control Instrumentation</p> <p>-C 33.2 Susceptibility of Process Control Instrumentation to AC Power Main Disturbances</p>		<p><u>SCIENTIFIC APPARATUS MAKERS ASSOCIATION (SAMA)</u></p> <p>Applies to susceptibility of industrial and process-control instrumentation to radiated EM energy. Establishes a classification of EM environments and defines test methods for evaluating instrumentation used in such EM environments.</p> <p>Applies to the susceptibility of industrial-process-control instrumentation to electrical disturbances on the ac power lines. A common reference point for evaluating the performance of this instrumentation is established. Various forms of disturbances are classified, and test methods for evaluating the instrumentation susceptibility are defined.</p>			

ARINC Document List, Aeronautical Radio Inc. (ARINC), issued annually.

Aviation Services, Federal Communications Commission (FCC) Rules and Regulations, Part 87, Volume V.

Frequency Management Principles, Spectrum Engineering Measurements, Federal Aviation Administration (FAA) Handbook 6050.23, May 1969.

Land Mobile

Domestic Public Radio Services, Federal Communications Commission (FCC) Rules and Regulations, Part 21, Volume VII.

Public Safety Radio Services, Federal Communications Commission (FCC) Rules and Regulations, Part 89, Volume V.

Industrial Radio Services, Federal Communications Commission (FCC) Rules and Regulations, Part 91, Volume V.

Land Transportation Radio Services, Federal Communications Commission (FCC) Rules and Regulations, Part 93, Volume V.

Mobile Services, International Radio Consultative Committee (CCIR) Study Group 8, Volume VIII, Kyoto, Japan, 1978.

Manual of Regulations and Procedures for Radio Frequency Management, National Telecommunications and Information Administration (NTIA), continually updated.

Marine Services

Stations on Shipboard in the Maritime Services, Federal Communications Commission (FCC) Rules and Regulations, Part 83, Volume IV.

Manual of Regulations and Procedures for Radio Frequency Management,
National Telecommunications and Information Administration (NTIA), continually
revised.

Point-to-Point Communications

Domestic Public Radio Services, Federal Communications Commission
(FCC) Rules and Regulations, Part 21, Volume VII.

International Fixed Public Radio-Communications Services, Federal
Communications Commission (FCC) Rules and Regulations, Part 23, Volume VII.

Stations on Land in the Maritime Services and the Alaska Public-Fixed
Stations, Federal Communications Commission (FCC) Rules and Regulations, Part
81, Volume IV.

Fixed Service at Frequencies Below About 30 MHz, International Radio
Consultative Committee (CCIR) Study Group 3, Volume III, Kyoto, Japan, 1978.

Fixed Service Using Communication Satellites, International Radio
Consultative Committee (CCIR) Study Group 4, Volume IV, Kyoto, Japan, 1978.

Fixed Service Using Radio Relay Systems, International Radio
Consultative Committee (CCIR) Study Group 9, Volume IX, Kyoto, Japan, 1978.

Satellite Communications, Federal Communications Commission (FCC)
Rules and Regulations, Part 25, Volume VII.

Manual of Regulations and Procedures for Radio Frequency Management,
National Telecommunications and Information Administration (NTIA), continually
updated.

Broadcast Communications (AM, FM, TV, International)

Radio Broadcast Services, Federal Communications Commission (FCC)
Rules and Regulations, Part 73, Volume III.

Broadcasting Service (Sound), International Radio Consultative
Committee (CCIR) Study Group 10, Volume X, Kyoto, Japan, 1978.

Broadcasting Service (Television), International Radio Consultative
Committee (CCIR) Study Group 11, Volume XI, Kyoto, Japan, 1978.

CISPR Limits of Radio Interference and Report of National Limits,
International Special Committee on Radio Interference (CISPR) Publication 9,
International Electrotechnical Commission, Geneva, Switzerland.

Radio Frequency Devices, Federal Communications Commission (FCC)
Rules and Regulations, Part 15, Volume II.

Manual of Regulations and Procedures for Radio Frequency Management,
National Telecommunications and Information Administration (NTIA), continually
updated.

Amateur and Citizens Band Services

Amateur Radio Service, Federal Communications Commission (FCC) Rules
and Regulations, Part 97, Volume VI.

Citizens Radio Service, Federal Communications Commission (FCC) Rules
and Regulations, Part 95, Volume VI.

Navigation

Aeronautical Navigation

Aeronautical Communications Annex 10, International Civil Aviation Organization (ICAO), latest revision.

ARINC Document List, Aeronautical Radio Inc. (ARINC), issued annually.

Frequency Management Principles, Spectrum Engineering Measurements, Federal Aviation Administration (FAA) Handbook 6050.23, May 1969.

Geographical Separation Criteria for VOR, DME, TACAN, ILS, and VOT Frequency Assignments, Federal Aviation Administration (FAA) Handbook 6050.5A, March 1969.

Aviation Services, Federal Communications Commission (FCC) Rules and Regulations, Part 87.

Manual of Regulations and Procedures for Radio Frequency Management, National Telecommunications and Information Administration (NTIA), continually updated.

Maritime Navigation

Stations on Shipboard in the Maritime Services, Federal Communications Commission (FCC) Rules and Regulations, Part 83.

Manual of Regulations and Procedures for Radio Frequency Management, National Telecommunications and Information Administration (NTIA), continually updated.

Noncommunication Devices

Incidental Radiation Devices

Section 15 of the FCC Rules and Regulations: The requirements, technical specifications, and equipment authorization procedures for an incidental and restricted radiation device, which apply to the marketing of such a device, are set forth herein. The manufacture and marketing of such a device without prior Commission authorization is prohibited by section 302 of the Communications Act of 1934, as amended. (Details are being added on (1) security and alarm devices, (2) data processing equipment, and (3) switching power supplies.)

Industrial, Scientific, and Medical

Section 18 of the FCC Rules and Regulations: The requirements, technical specifications, and equipment authorization procedures for industrial, scientific, and medical devices which apply to the marketing of such a device, are set forth herein. The manufacture and marketing of such a device without prior Commission authorization is prohibited by section 302 of the Communications Act of 1934, as amended. (Section 18 is undergoing a complete rewrite, basically to follow CISPR Recommendations.)

SECTION 3

FOREIGN NATIONAL EMC STANDARDIZATION AND REGULATION

INTRODUCTION

For most European countries, the interference-control regulations will eventually be unified and will be based upon a European Economic Community Directive that is being developed. The directive is based upon the International Electrotechnical Commission, International Special Committee on Radio Interference (IEC/CISPR) recommendations and publications. Since West Germany's interference regulations are harmonized with IEC/CISPR recommendations, it is expected that most countries in Europe will follow West Germany's approach to interference control.

GERMAN INTERFERENCE-CONTROL LAWS

In the Federal Republic of Germany (West Germany), the interference-control laws have been written and the technical and administrative organizations have been established to enforce the limits. The International Telecommunications Union Treaty of 1947 is the foundation of the "Law for the Operation of High Frequency Apparatus, dated 9 August 1949." The law assigns the responsibility of interference control to the Minister fuer das Post und Fernmeldewesen (DP-FTZ) (FTZ, Referat C-24. Am Kavalleriesand, D-6100 Darmstadt, West Germany) who enforces the administrative regulation that stipulates if equipment meets a specified interference limit (i.e., VDE 0875), a "General Permit" is issued. The proof of compliance with the limits is the "Radio Protection Emblem" issued by the VDE Testing Station that must be affixed to the equipment.

VDE Organizations

The VDE consists of three distinct organizations that work together to advance electrotechnology. Verband Deutscher Elektrotechniker (VDE) is the Association of German Electrical Engineers, which consists of dues-paying members. As part of this voluntary effort, the VDE Regulations are prepared

by VDE Standards Committees (VDE Normen Ausschuss). Individual regulations are written for personnel safety, consumer protection, reliability, and to harmonize German and international standards. Each new regulation has a well-publicized review that is coordinated with the German Standards Institute (Deutsches Institute fuer Normen, DIN) and the German Electrotechnical Commission (Deutsche Elektrotechnische Kommission, DEK). New VDE regulations also receive a DIN number that is based on the last three digits of the VDE number, e.g., VDE 0874, 10 73, becomes DIN 57874.

The second organization is the VDE Publishing House (VDE Verlag) with offices in Berlin (1 Berlin 12, Bismarkstrasse 33) and Offenbach (D-6050 Offenbach, Merianstrasse 29). The VDE regulations and draft regulations may be ordered from either office.

The third organization is the VDE Testing Station (VDE Pruefstelle) at D-6050 Offenbach, Merianstrasse 28. The VDE Testing Station has been in existence since 1920.

VDE Testing Station

The VDE Testing Station is a quasi-independent institution of the Association of German Electrical Engineers (VDE). Management of the VDE Testing Station is controlled by the Board of the Testing Station of the VDE, a standing committee that determines the work areas and fee structure and draws its members from firms which have an interest in the work of the testing station. The Director of the VDE Testing Station is responsible for the management of the testing station and for the proper performance of the tests. The Director makes the decision to grant, reject, or withdraw the permission to use a VDE Emblem. All of the decisions of the testing station may be contested by filing a complaint with the VDE Board. The work areas and fees of the testing station are determined by the VDE Board. The work of the testing station is chartered to be for the common good and extends over the following areas:

1. Safety tests for the VDE Emblem
2. Radio-frequency interference-suppression tests
3. Qualification tests for electronic components
4. General investigations
5. Administration of the VDE Testing Station.

The measurement of radio-frequency interference originating from electrical appliances and the effectiveness of interference-suppression measures was undertaken by the testing station in 1951. Contractual agreements between the German Postal Service and the VDE are the basis for the RFI measurements by the VDE. The VDE issues certificates of compliance for (1) equipment that generates RF energy intentionally (VDE 0871) and (2) radio and television receivers (VDE 0872.) The German Postal Service then issues a test number that must be affixed to the equipment. For equipment that generates interference as a by-product (VDE 0875), the VDE issues a permit to use the "Radio Protection Mark" that must be affixed to the equipment.

EMC-related standards of West Germany are listed in TABLE 3-1.

CANADIAN EMC STANDARDS

Canadian standards are issued by the Canadian Standards Association (CSA) which, chartered in 1919 and accredited by the Standards Council of Canada to the National Standards System in 1973, is a not-for-profit, non-statutory, voluntary membership association engaged in standards development and certification activities.

CSA standards, by reason of Association procedures, reflect a national consensus of producers and users -- including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted into regulations by municipal, provincial, and federal governments, particularly in the fields of health, safety, and the environment.

TABLE 3-1
EMC-RELATED STANDARDS OF WEST GERMANY
(Page 1 of 2)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
<p>VDE 0565-1975 VDE Regulation for Radio Interference Suppression Network Part 1-1978 Suppression Capacitors Part 2-1978 Suppression Choke Part 3-1975 Suppression Filters to 16 Amperes Part 4-1976 Ceramic Capacitors</p> <p>VDE 0871/11.81 (DIN 57 871) Radio Frequency Interference Suppression of Radio-Frequency Equipment for Industrial, Scientific, and Medical (ISM) and Similar Purposes</p> <p>VDE 0872, 7/72 Regulation for Radio and TV Receivers</p> <p>VDE 0874, 10/73 VDE Guidelines for Interference Suppression</p> <p>VDE 0875, 6/77 Regulation for Household Appliances (Unintentional RF)</p>	<p>CISPR 11 CENELEC MD 344</p>	<p>Applies to electrical equipment and installations that generate or utilize discrete frequencies or repetition frequencies above 10 kHz and are not used for telecommunication purposes.</p>			

TABLE 3-1
(Page 2 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Supervised Documents
VDE 0876 Part 1, 9/78 Regulation for Radio Interference Meters		Radio interference measuring receiver with weighted indication and accessories.			
VDE 0877 Part 1, 12/59 Procedure for Measurement of Interference Voltages					
Part 2-Procedure for Measurement of Interference Field Strength					
VDE 0879 Part 1 (Draft)-1975 Regulation for Interference Suppression of Vehicle Equipment and Internal Combustion Engines, Far-Field Suppression					

The Association offers certification and testing services in support of, and as an extension to, its standards development activities. By independent evaluation, CSA certification determines that products intended to bear the CSA Certification Mark, conform to accepted standards. This Mark is applied to over half a billion articles per year, ranging from plumbing products to medical devices, from household appliances to personal protective equipment, and from housing and construction materials to office machinery. In order to ensure the integrity of its certification process, the Association regularly and continually audits and inspects products that bear the CSA Mark.

In addition to its head office and laboratory complex in Rexdale (Metropolitan Toronto), CSA has regional branch offices in major centers across Canada and inspection and testing agencies in eight countries.

The C22.4 series of CSA EMC standards listed in TABLE 3-2 are a portion of the Canadian Electrical Code -- Part IV, Limits and Methods of Measurement of Electromagnetic Interference. These standards are in the process of being redesignated to the C108 series, some of which are also listed. They are legally binding by incorporation into the Canadian General Radio Regulations, Part I, amendment on Radio Interference Regulations.

EMC-related standards of Canada are listed in TABLE 3-2.

BRITISH EMC STANDARDS

British standards as listed in TABLE 3-3 are issued by the British Standards Institution, 2 Park Street, London W1A 2BS, UK. They are available from the Sales Branch, Newton House, 101/113 Pentonville Road, London, N.I.

EMC-related standards of Great Britain are listed in TABLE 3-3.

TABLE 3-2

EMC-RELATED STANDARDS OF CANADA

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
C22.4 No. 101-1972 Electromagnetic Interference Measuring Instruments	SAE J551.	Covers the requirements and accessories for the measurement of levels of electromagnetic interference, both conducted and radiated, as set forth in related CSA Standards on Tolerable Limits of EMI; does not necessarily describe a single instrument.			
C22.4 No. 104-1974 Tolerable Limits and Methods of Measurement of Radio Interference from Vehicles and Other Devices Having Internal Combustion Engines					
C22.4 No. 106 - 1971 Tolerable Limits of Electromagnetic Interference from Radio Frequency Generators -- Industrial, Scientific, and Medical		Applies to radiation and conduction of RF power liable to cause interference from any apparatus not licensed by the Department of Communications for radio communication but which contains an RF generator liable to cause radiation at any frequency.			
C22.4 No. 107 - 1949 (R1964) Tolerable Limits and Special Methods of Measurement of Radio Interference from Wire Communication and Signal Systems (1 errata)		Applies to radio interference (both transient and sinusoidal) originating on any part of communication or signal systems.			
C108.1.1 - 1977 Electromagnetic Interference Measuring Instruments -- CISPR Type		Sets forth the characteristics of an instrument conforming to CISPR requirements for the measurement of EMI, both conducted and radiated, in the frequency range 0.15 to 1000 MHz, as set forth in related CSA Standards on Tolerable Limits of EMI.			
C108.3.1 - 1975 Tolerable Limits and Methods of Measurement of Electromagnetic Interference from Alternating Current High Voltage Power Systems 0.15 MHz - 30 MHz		Applies to electromagnetic interference originating with ac electric power lines and associated generating and distributing stations for voltages up to 765 kV phase-to-phase. Frequency limits apply from 0.15 to 30 MHz.			
C108.5.4 - 1975 Tolerable Limits and Methods of Measurement of Line Conducted Interference from Low Voltage Apparatus (0.49 MHz - 30 MHz)					
CR-1, RSC 1970 Radio Interference Regulations (RIR-5)		Limits for radio noise from an ISM radio-frequency generator that is used in Canada.			
RS-161 Issue 1 Interference Limits & Test Procedures for Airborne Electronic Equipment Intert		Sets forth interference limits and test procedure to determine compliance with the requirements of the relevant Radio Standards Specifications under the following conditions: airborne radio and radar equipment shall operate satisfactorily alone and with other such equipment that may be installed nearby.			
265-1966 Radiation Hazards from Electronic Equipment		Compliance required by manufacturers and users of electronic equipment.			

TABLE 3-3
EMC-RELATED STANDARDS OF GREAT BRITAIN^a
(Page 1 of 2)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
BS 613: 1977 Components and Filter Units for EMI Suppression		Specifies requirements and tests for components and filter units for EMI suppression for use in electrical machines, appliances, and apparatus rated at up to 7 kVA, operating from 50 to 60 Hz electricity supplies above extra low voltage and up to and including 240 V single-phase or 415 V 3-phase. Also applies to dc rated components.			
BS 727 Radio Interference Measuring Apparatus for the Frequency Range 0.015 MHz to 1000 MHz	BS 905.	Defines the characteristics and performance of apparatus for measuring radio interference voltages and fields in the frequency range 0.015 to 1000 MHz, as follows: (1) broadband radio noise, using quasi-peak and peak direction (2) sine-wave interference			
BS 900 Limits of Radio Interference		Specifies limits of the magnitude of radio-noise terminal voltages and radio-noise fields throughout the ranges 200 to 1605 kHz and 40 to 70 MHz. The specified limits apply to equipment that is directly connected to a distribution system with a declared voltage between conductors not greater than 500 volts or a declared voltage between any one conductor and earth not greater than 250 volts. The specified limits for radio-noise fields also apply to electrical equipment that is entirely self-contained, i.e., that is not connected to electric supply wiring.	1:3/63		
BS 827: 1939 Radio Interference Suppression for Trolley-Buses and Tramways		Prescribes the limits of the interference-producing electric field set up by the electrical equipment of tramcars and trolley-buses, and by associated overhead lines, as measured in the range 200-1500 kHz and at a prescribed distance from the source of interference. Also gives the standard rating and certain safety requirements for components used for the purpose of reducing interference.			
BS 833: 1970 Radio Interference Limits and Measurements for the Electrical Ignition Systems of Internal Combustion Engines		Provides for protection of the reception of sound and TV signals from 40 to 250 MHz and prescribes limits of radiation from the ignition systems of internal combustion engines. Specifies the method of measurement to be used for compliance testing and for insertion loss of components used in making up radio-interference suppression devices for ignition systems (not aircraft ignition systems).			
BS 905: 1969 Radio Interference Limits and Measurements for Television and VHF Sound Receivers	IEC Publications 106 and 106A, BS 727, and BS 3041.	Provides for protection of the reception of sound and television signals and prescribes limits of permissible radio interference characteristics of radio receivers for broadcast television and FM sound reception. It specifies the method of measurement to be used for testing for compliance with the limits that are based upon compliance by 80% of receiver production.			

^aBS: British Standard
CF: Code of Practice

TABLE 3-3
(Page 2 of 2)

Number-Date Title	Coordinated Document	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MS 1597: 1975 Specification for Radio Interference Suppression on Marine Installations		Specifies limits and methods of measurement for EMI generated by the electrical and electronic equipment of a marine (shipboard) installation. Limits in the frequency range 15 kHz to 100 MHz are specified for RF voltage or current appearing at the terminals of electronic equipment and voltages appearing in the aerial feeder.			
MS 3549 Methods for Measuring and Expressing the Performance of Television Receivers		Describes methods of measuring the electrical, acoustical, and optical properties of broadcast TV receivers designed for monochrome, primarily for the United Kingdom, positive modulation TV system with its associated AM sound. Where necessary, the differences for use with 525, 625, and 819 lines, negative modulation, and PM sound are indicated.	Amendment 1 2/28/57		
CP 327-201: 1951 The Reception of Sound and Television Broadcasting		Covers recommendations for good reception of sound broadcasts on the usual long-, medium-, and short-wave bands of television receivers.			
CP 1001 Abatement of Radio Interference Caused by Motor Vehicles and Internal-Combustion Engines			Amendment 1 12/57		
CP 1002: 1947 Abatement of Radio Interference from Electro-Medical and Industrial Radio-Frequency Equipment		Gives guidance to designers, manufacturers, installers, and users of those types of industrial and medical equipment that generate RF energy in the course of normal operation, but which are not required to radiate such energy into free space as part of their normal function.			
CP 1006: 1955 General Aspects of Radio Interference Suppression		Gives guidance for the suppression of radio, including television, interference, i.e., the effect of any signal or disturbance that can mar the reception of a wanted program or signal. Concerned only with interference caused by electrical apparatus and installations.	Amendment 1 5/62		

JAPANESE INDUSTRIAL STANDARDS

Japanese industrial standards are used by both commercial and governmental organizations involved in design engineering, quality assurance, research and development, construction, testing, and maintenance. They are grouped into 17 specific divisions, of which the Electrical Engineering division contains most of the EMC-related standards. Although adequate information on them was not available by the publication date for this revision of the EMC Standards Handbook, a listing of such standards is planned for later revisions.

SECTION 4

INTERNATIONAL EMC STANDARDIZATION

There are several international standards organizations that play an important role in EMC.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

The IEC was founded in 1906 to promote international cooperation in the electrotechnical industry. The IEC has originated a multilanguage vocabulary with more than 100,000 terms, originated the "International System" (S.I.) of units of measurement, and established worldwide standards for electrical equipment and installations. There are 42 national committees of which one of these is the CISPR.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

The ISO develops voluntary standards in many areas on a worldwide basis. Of interest is ISO Technical Committee (TC) 97 on computers and information processing and its Subcommittee (SC) 6 on data communications. ANSI represents the U.S. on ISO/TC 97 and coordinates proposed ISO standards on the national level.

INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)

The CCIR, together with the International Telegraph and Telephone Consultative Committee (CCITT), is part of the International Telecommunications Union (ITU) and was established to promote standardized radio communications on a worldwide basis. Reports and recommendations published by the CCIR have been used and will continue to be used as a basis for developing radio-communications standards.

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE (CISPR)

The Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference) was founded in 1934. It promotes international agreement on many aspects of radio interference (such as methods of measurement and limits for conducted or radiated interference from many different apparatus and appliances and their statistical interpretation) with the primary objectives of fostering satisfactory reception of radio and television broadcasting services and of facilitating international trade. Interference between transmitters of radiocommunication services is not in the domain of CISPR. [This is a matter which directly concerns the ITU and for which this Union, on the advice of its CCIR, itself prepares recommendations and issues regulations (Radio Regulations).] CISPR has three subcommittees (on limits, on methods of measurement, and on safety) which meet in plenary assembly every 3 years. Inputs to these subcommittees are furnished by 10 working groups that meet usually annually to discuss specific study questions which may lead to a report. In many cases, they lead to recommendations; member national committees of the International Electrotechnical Committee then may ask their governments to approve pertinent legislation.

INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (CCITT)

The CCITT is a civil organization that is part of the ITU and was established to promote standardized telegraph and telephone communications on a worldwide basis. Most of the European commercial communications systems follow the CCITT recommendations.

Figure 4-1 illustrates the interrelation of some of these and national organizations.

International EMC-related standards are listed in TABLE 4-1.

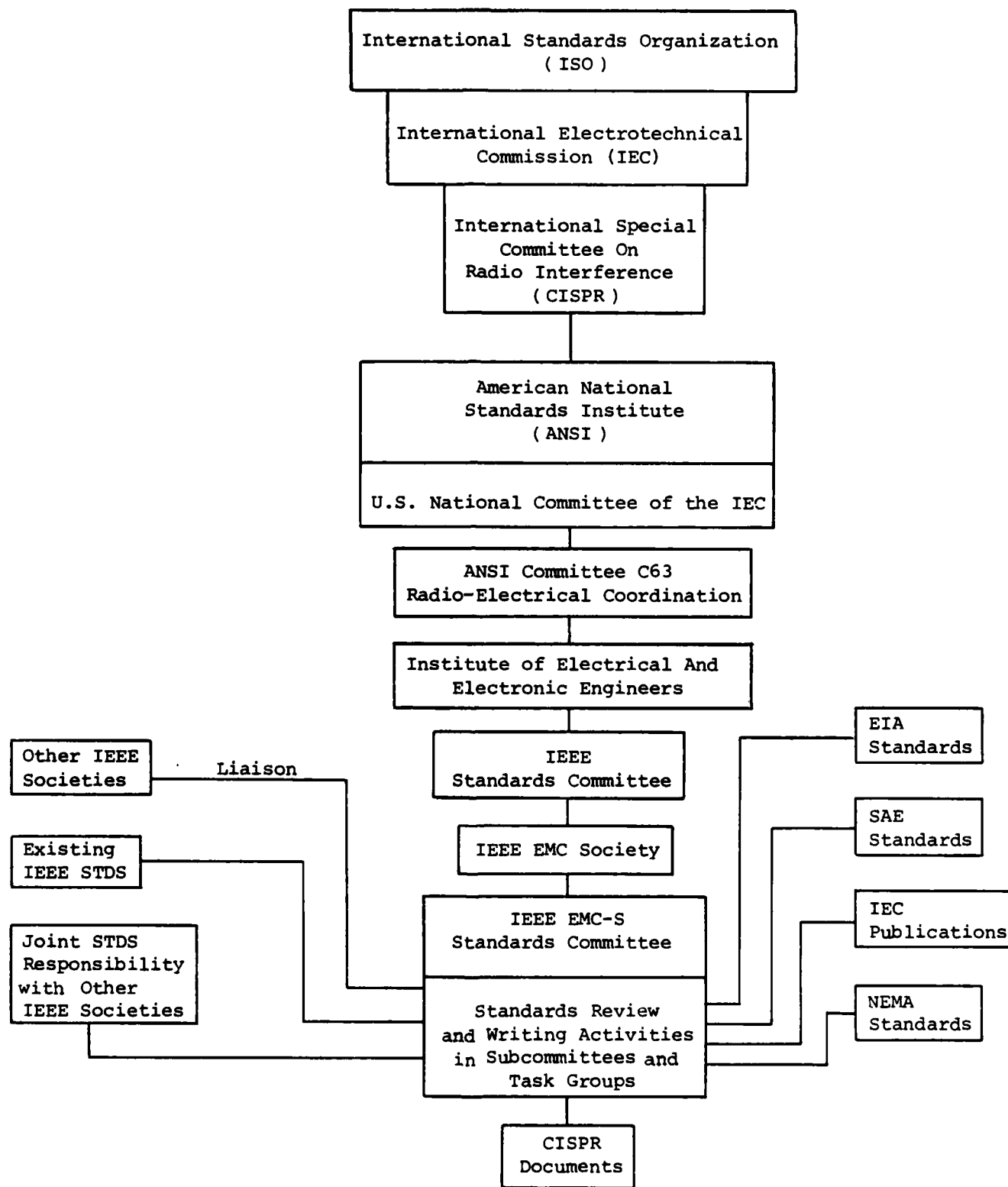


Figure 4-1. Role of EMC standards activities leading to national or international standardization.

TABLE 4-1
INTERNATIONAL EMC-RELATED STANDARDS^a
(Page 1 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
<p>IEC 106-74 Recommended Methods of Measurement of Radiated and Conducted Interference from Receivers and Amplitude-Modulation, Frequency-Modulation, and Television Broad- cast Transmissions, Second Edition</p> <p>IEC 107-77 Recommended Methods of Measurement on Receivers for Television Broadcast Transmissions, Part 1: General Considerations Electrical Measure- ments Other Than Those at Audio- Frequencies, Second Edition</p> <p>IEC 215-67 Safety Requirements for Radio Transmitt- ing Equipment, Part 2: Test Methods First Edition</p> <p>IEC 244-68 Methods of Measure- ment for Radio Transmitters, Part 1: General Conditions of Measurement, Frequency Output Power, and Power Consumption, First Edition</p> <p>IEC 244-69 Methods of Measure- ment for Radio Transmitters, Part 2: Bandwidth, Out-of- Band Power, and Power of Non-Essential Oscillations</p>		<p><u>INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)</u></p> <p>This recommendation is to standardise the conditions and methods of measurement to be used for the study of the radiation from broadcast radio and television receivers, so as to make possible the comparison of the results of radiation measurements obtained by different observers. Limiting values of the various quantities for acceptable performance are not specified.</p>	<p>Amendment 1, 1973</p> <p>Amendment 1, 1973 Supplement 1, 1968 Amended 1973</p> <p>Amendment 1, 1974 Supplement 1, 1968 Amended 1973</p>	<p>IEC 107-60</p>	

^aPlans in table will be completed at a future issue.

TABLE 4-1
(Page 2 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEC 244-72 Methods of Measurement for Radio Transmitters, Part 3: Wanted and Unwanted Modulation, Unwanted Modulation Including Hum and Noise Modulation, First Edition			Supplement 1, 1971 Supplement 2, 1972		
IEC 244-73 Methods of Measurement for Radio Transmitters, Part 4: Amplitude/Frequency Characteristics and Non-Linearity Distortion in Transmitters for Radiotelephony and Sound Broadcasting, First Edition			Supplement 1, 1976		
IEC 244-71 Methods of Measurement for Radio Transmitters, Part 5: Measurements Particular to Transmitters and Transposers for Monochrome and Color Television, First Edition			Supplement 1-3, 1977 Amendment 1, 1975, to Supplement 2		
IEC 244-76 Methods of Measurement for Radio Transmitters, Part 6: Cabinet Radiation at Frequencies Between 130 kHz and 1 GHz, First Edition					
IEC 244-79 Methods of Measurement for Radio Transmitters, Part 7: Cabinet Radiation at Frequencies Above 1 GHz, First Edition					

TABLE 4-1
(Page 3 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEC 315-70 Methods of Measure- ment on Radio Receivers for Various Classes of Emission, Part 1: General Conditions for Measurement and Measuring Methods Applying to Several Types of Receivers, First Edition			Supplement 1 1971 Errata 1971		IEC 69-54
IEC 315-71 Methods of Measure- ment on Radio Receivers for Various Classes of Emission, Part 2: Measurements Particularly Related to the Audio- Frequency Part of a Receiver, First Edition					
IEC 315-72 Methods of Measure- ment on Radio Receivers for Various Classes of Emission, Part 3: Radio- Frequency Measure- ments on Receivers for Amplitude- Modulated Emission, First Edition					
IEC 315-73 Methods of Measure- ment on Radio Receivers for Various Classes of Emission, Part 4: Specialized Radio-Frequency Measurements on FM Receivers of the Response to Impulsive Interference, First Edition					
IEC 315-74 Methods of Measure- ment on Radio Receivers for Various Classes of Emission, Part 5: Radio- Frequency Measure- ments on Professional Receivers for FM Teleggraphy Systems, First Edition					

TABLE 4-1
(Page 4 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEC 437-73 Radio Interference Test on High-Voltage Insulators, First Edition					
IEC 469-74 Pulse Techniques and Apparatus, Part 1: Pulse Terms and Definitions, First Edition					
IEC 469-74 Pulse Techniques and Apparatus, Part 2: Pulse Measurement and Analysis, General Considerations, First Edition					
IEC 499-76 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 1: General Definitions and Standard Conditions of Measurement, First Edition					
IEC 499-78 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 2: Transmitters Employing A3 or F3 Emissions, First Edition					
IEC 499-79 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 3: Receivers for A3 or F3 Emissions, First Edition					
IEC 499-80 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 4: Transmitters Employing SSB Emissions (A3A, A3M, or A3J), First Edition					

TABLE 4-1
(Page 5 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
IEC 489-79 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 5: Receivers Employing SSB Emissions (A3A, A3M, or A3J), First Edition			Supplement 1, 1976 Supplement 2, 1977		
IEC 489-74 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 6: Methods of Measurement for Signalling Equipment, First Edition					
IEC 489-76 Methods of Measure- ment for Radio Equip- ment Used in the Mobile Service, Part 7: Privacy Equipment Supplemen- tary Definitions, First Edition					
IEC 510-75 Methods of Measure- ments for Radio Equipment Used in Satellite Earth Stations, Part 1: General, First Edition					
IEC 510-78 Methods of Measure- ments for Radio Equipment Used in Satellite Earth Stations, Part 2: Measurements for Subsystems -- Section 1, General; Section 2, Antenna (Including Feed Network), First Edition					

TABLE 4-1
(Page 6 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
<p>IEC 512-77 Electromechanical Components for Electronic Equipment, Basic Testing Procedures, and Measuring Methods, Part 9: Cable-Clamping Tests, Experimental Hazard Tests, Chemical Assistance Tests, Fire Hazard Tests, RF Resistance Tests, Capacitance Tests, Shielding and Filtering Tests, and Magnetic Interference Tests, First Edition</p> <p>IEC 533-77 Electromagnetic Compatibility of Electrical and Electronic Installations in Ships, First Edition</p> <p>IEC Chapter 902-1973 Advance Edition of International Electrotechnical Vocabulary, Radio Interference</p>		<p>INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)</p>	<p>Amendment slip 1978</p>		
<p>ISO 1540-77 Aerospace Characteristics of Aircraft Electrical Systems, First Edition</p> <p>ISO 2650-74 Environmental Tests for Aircraft Equipment, Part 1: Scope and Applicability, First Edition</p> <p>ISO 2676-75 Environmental Tests for Aircraft Equipment, Part 4.1: Magnetic Influence</p> <p>ISO/TR1352-74 Acoustics-Assessment of Noise with Respect to its Effect on the Intelligibility of Speech, Recommendation</p>					

TABLE 4-1
(Page 7 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
<p>Recommendations CCIR 239 Limits and Measurement Methods for Spurious Emissions from Broadcast and TV Receivers</p> <p>CCIR 329-2 Definitions, Limits, and Measurement Methods of Spurious Radiation</p> <p>CCIR 334-1 Measurement of Performance of Broadcast and TV Receivers to Impulsive and Quasi-Impulsive Interference</p> <p>CCIR 378-1 Accuracy of Field Strength by Monitoring Stations</p> <p>CCIR 442 Expedient Method of Field Strength Measurement at Monitoring Stations</p> <p>CCIR 443 Measurement Methods of Determination of Tolerable Levels of Radio-Electronic Interference</p> <p>Report CCIR 758-1 Measurement of Manmade Radio Noise</p>	<p>(See also Study Programme 20A- 1/6 and 21A-1/6.)</p>	<p><u>INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)</u></p> <p><u>INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE (CISPR)</u></p>	<p>1A-1975 Supplement 1 Supplement 1, 1966 Amendment 1, 11/67</p>		
<p>CISPR 1-1972 Specifications for Radio Interference Measuring Apparatus for the Frequency Range 0.15 MHz to 30 MHz</p>		<p>Stipulates performance requirements for radio interference measuring apparatus including the associated standard artificial mains network. Also specifies the requirements that have to be met in the measurement of noise voltage at the terminals of inter- ference producing apparatus and in the measurement of noise fields from such.</p>			

TABLE 4-1
(Page 8 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
CISPR 2-1975 Specification for Radio Interference Measuring Apparatus for the Frequency Range 25 MHz to 300 MHz		Stipulates performance requirements for radio interference measuring apparatus including associated standard artificial mains network. Also specifies requirements that have to be met in measurement of noise voltages at the terminals of interference producing apparatus and in the measurement of noise fields from such apparatus.			
CISPR 3-1975 Specification for Radio Interference Measuring Apparatus for the Frequency Range 10 kHz to 150 MHz					
CISPR 4-1967 CISPR Measuring Set Specifications for the Frequency Range 300 MHz to 1000 MHz		Stipulates performance requirements for radio interference measuring apparatus for the frequency range 300 to 1000 MHz and also requirements that have to be met in the measurement of noise fields related from interference-producing apparatus.	4A-1975 Supplement 1		
CISPR 5-1967 Radio Interference Measuring Apparatus Having Detectors Other Than Quasi-Peak		Stipulates performance requirements for radio interference measuring apparatus, employing an rms output voltmeter, to be used in conjunction with the CISPR specification for radio interference measuring apparatus appropriate to the frequency range considered.			
CISPR 6-1976 Specification for an Audio- Frequency Interference Voltmeter					
CISPR 7-1969 Recommendations of the CISPR Amendment 1-1973		Recommendations of CISPR on matters relating to radio interference and its suppression.	7A-1973 Supplement 1 7B-1975 Supplement 2		
CISPR 8-1969 Reports and Study Questions of the CISPR Amendment 1-1975			8A-1973 Supplement 1 8B-1975 Supplement 2		
CISPR 9-1976 CISPR Limits of Radio Interference and Leakage Currents According to CISPR and National Regulations	CISPR-7	The limits of interference recommended by the CISPR for national adoption are presented in tabular form; full texts are given in CISPR Publication 7. National limits of interference are also listed where these are the same.	New draft being reviewed.		
CISPR 10-1976 Organization, Rules, and Members of the CISPR					

TABLE 4-1
(Page 9 of 9)

Number-Date Title	Coordinated Documents	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
CISPR 11-1975 Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, and Scientific, and Medical (ISM) Radio Frequency Equipment (Excluding Surgical Diathermy Apparatus)			Amendment 1 - 1976 11B - 1976 Supplement 1		
CISPR 12-1975 Limits and Methods of Measurement of Radio Interference Characteristics of Ignition Systems of Motor Vehicles and Other Devices		Applies to the radiation of electromagnetic energy from motor vehicles and other devices equipped with internal combustion engines that may cause interference to radio reception.			
CISPR 13-1975 Limits and Methods of Measurement of Radio Interference Characteristics of Sound and Television Receivers					
CISPR 14-1975 Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools, and Similar Electrical Apparatus					
CISPR 15-1975 Limits and Methods of Measurement of Radio Interference of Fluorescent Lamps and Luminaire					
CISPR 16-1977 Specification for Radio Interference Measuring Apparatus and Measurement Methods, First Edition					
CISPR 17-1981 Methods of Measurement of the Suppression Characteristics of Passive Radio Interference Filters					

APPENDIX A

SUMMARY OF MIL-STD-461B REQUIREMENTS (Reprint)^{A-1}

2

IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY, VOL. EMC-24, NO. 1, FEBRUARY 1982

Application Tables for MIL-STD-461B

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Abstract—The complexity in application of MIL-STD-461B is reduced by use of tables which summarize requirements of the standard. A separate table is provided for a group of limits applicable to each type of test procedure.

Key Words—MIL-STD-461B, application tables.

DESCRIPTION

MIL-STD-461B [1] is the basic and complex EMC standard based upon a variety of test procedures in MIL-STD-462 with some procedures yet to be issued. The limiting acceptable values are sometimes uniform across the branches of service, but also are often different to reflect differing needs among the services. As a result, a vast array of requirements meets a user of MIL-STD-461B. To organize these in a (comparatively) simplified format and permit ready application is the objective of this paper.

Tables I-V describe the classes of equipment/subsystems on which the limits are imposed. Basic categories are listed in Table I, with subclasses further detailed in Tables II-IV.

Tables V-XXV summarize applicable limits for these classes on the basis of one particular type of test, for example, "CE01 CONDUCTED EMISSIONS: POWER/INTERCONNECTING LEADS (30 Hz-15 kHz)." This table, as well as others, notes both the intended applications for these limits and pertinent limitations. Limits are provided for each class of equipment/subsystems in terms of a simple equation for each frequency range. Equations normally involve $\log f$ (frequency) and a few constants. For ready visualization, a sketch of each is provided. Special conditions are provided in footnotes.

Although these tables are intended as a fast-access summary of MIL-STD-461B, initial use may require checking with the standard until confidence in the tables is established, and to

insure that the latest requirements are imposed. To facilitate such checking, a part number of the standard is related to its corresponding equipment classification number in Table I.

EXAMPLES

To illustrate use of the application tables, consider two examples. For the first of these, assume an aircraft trainer is to undergo the CE03 Conducted Emissions tests on power and interconnecting leads. From Table IV, trainers are in Class A3. In the CE03 application table, separate listings are shown under Equipment Class A3 for Army (A), Navy (N), and Air Force (AF) requirements. (Others applicable to all services are denoted by X.) Narrow-band (NB) emissions limitations for both the Army and the Air Force are found on the first and second lines of the table for the frequency range 15 kHz to 2 MHz and the seventh and eighth lines for 2 to 50 MHz. (The lower portion of the table provides broad-band (BB) limits.) These are expressed in dB μ A by $29.3-31.1 \log f$, where the frequency f is in MHz. Thus limits at 1 and 2 MHz would be, respectively, 29.3 dB μ A and $29.3-31.1 \log 2 = 38.7$ dB μ A. On the other hand, narrow-band emission limits from 15 kHz to 2 MHz for the Navy, lines 4 through 6, depend upon the supply frequency (dc, 60 Hz, 400 Hz) and the supply current for values greater than 1.4 (note c).

For a second example, assume a crash rescue truck is to undergo the UM03 Radiated Emissions test. From the UM03 applications table, a crash rescue truck is a piece of Group I equipment. In the table, broad-band limits are provided on lines 1 and 4. In units of dB μ V/m/MHz, they are $79.7-10.7 \log f$ for 0.15-200 MHz and $5.6 + 21.5 \log f$ for 0.2-1 GHz. Values at 1 MHz and 0.2 GHz are, respectively, 79.7 dB μ V/m/MHz and $79.7-10.7 \log 200$ (or $5.6 + 21.5 \log 200$) = 55.0 dB μ V/m/MHz.

REFERENCES

Manuscript received September 1, 1981.

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- [1] MIL-STD-461B, *Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference*, Dept. of Defense, Apr. 1, 1980.

^{A-1} Appendix A has been published as a technical paper: Schulz, R. B., "Application Tables for MIL-STD-461B," *IEEE Trans. EMC*, Vol. EMC-24, pp. 2-11, February 1982.

SCHULZ: APPLICATION TABLES

3

TABLE I
EQUIPMENT/SUBSYSTEM CLASSES

MIL-STD-461B Part No. ^a	Class	Description	Sub-Class Tables	
			Army	N/AF
	A	Equipment and subsystems that must operate compatibly when installed in critical areas, such as the following platforms or installations: Aircraft (including associated ground-support equipment) Spacecraft and launch vehicles (including associated ground-support equipment) Ground facilities (fixed and mobile, including tracked and wheeled vehicles) Surface ships Submarines	A-5	A-3
2	A1			
3	A2			
4	A3			
5	A4			
6	A5			
7	B	Equipment and subsystems that support the Class A equipments and subsystems but will not be physically located in critical ground areas. Examples are electronic ship maintenance and test equipment used in non-critical areas; aerospace ground equipment used away from flight lines; theodolites, navigators, and similar equipments used in isolated areas. Miscellaneous, general-purpose equipments and subsystems not usually associated with a specific platform or installation. Specific items in this case are:	A-4 A-5	
8	C1	Tactical and special-purpose vehicles and engine-driven equipment	See UM 03	
9	C2	Engine generators and associated components, uninterruptible power sets (UPS), and mobile electric-power (MEP) equipment supplying power to, or used in, critical areas	See UM 04	
10	C3	Commercial electrical or electromechanical equipment.	See UM 05	

^aPart 1 concerns general requirements.

TABLE II
CATEGORIES OF CLASS A1 EQUIPMENTS AND SUBSYSTEMS
(For Air Force and Navy Use)

Category	Description
A1a	Air-launched
A1b	Equipment installed on aircraft (internal or external to airframe)
A1c	Aerospace ground equipment required for the checkout and launch of aircraft, including electronic test and support equipment
A1d	Trainers and simulators
A1e	Portable medical equipment used for aeromedical air lift
A1f	Aerospace ground equipment used away from the flight line, such as engine test stands and hydraulic test fixtures
A1g	Jet-engine accessories

TABLE III
CATEGORIES FOR CLASS A2 EQUIPMENTS/SUBSYSTEMS
(For Army, Navy, and Air Force Use)

Category	Description
A2a	Equipment installed on spacecraft or launch vehicle
A2b	Aerospace ground equipment required for checkout and launch, including electronic test and support equipments.
A2c	Trainers and simulators

TABLE IV
EQUIPMENTS AND SUBSYSTEMS
(For Army, Navy, and Air Force Use)

Items Common to Classes A1 (Army Only) A3, A4, A5	Additional Items
Receivers Transmitters Antenna, Multi- couplers Intercom/Inter- phone Modem Repeater Amplifier, Power/ Audio Multiplexers Laser Devices IR Devices Transponders Beacons Power Supplies Inertial Guidance Teletypewriters Recorders Visual Displays Digital Equipment Data Annotation Camera Data Telephone SWBD Servo/Synchro Test Equipment Time/Frequency STDS Ultrasonic Devices Telephones	<u>Class A1 (Army Only)</u> Amplifier, Tuned RF Amplifier, Untuned RF Sensors/Antennas <u>Class A3</u> Amplifier, Tuned RF Amplifier, Untuned RF Sensors, Antennas Commercial, Equipment (Army Only) Trainers/Simulators <u>CLASS A4</u> Amplifier, Tuned RF Amplifier, Untuned RF Manpack or Helmet with Self-contained batteries Manpack or Helmet Using Ship Power Sensors Receive-Signal Junction-Switching Connection Boxes Sonar Devices <u>CLASS A5</u> Amplifier, Untuned Sensors Receiver-Signal Junction-Switching Connection Boxes Sonar Devices All Others Not Listed Here

TABLE V
CE01 CONDUCTED EMISSIONS: POWER/INTERCONNECTING
LEADS (30 Hz-15 kHz)

Applications: External leads: ac/dc power, ground, control, signal (limited).
 Limitations: Class A1: ASW aircraft only.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	EMISSION		LIMITS (BW = 75 Hz)		UNITS	SKETCH
	EXTERNAL LEADS	BW	FREQUENCY RANGE	f (in kHz)		
	Ac/dc power, control ^b	HB	30 Hz - 2 kHz 2 - 15 kHz (Same as for A1, A2)	130 145.1 - 50.1 log f	dBμA	
	Dc power, control					
	Dc ≤ 1A ^c , control ^d , signal ^d		30 - 400 Hz 0.4 - 15 kHz	120 103.6 - 41.3 log f		
	60 Hz: ^e 1 kVA ^f 1 kVA		60 Hz - 15 kHz 120 Hz - 1.2 kHz 1.2 - 15 kHz	92.0 - 22.3 log f 90 92.0 - 22.9 log f		
	400 Hz: ^g [12A, 16, 115V] ^h above		0.4 - 9 kHz 8 - 15 kHz 0.4 - 15 kHz	90 110.9 - 22.9 log f 110.3 - 22.9 log f		

^a For Army, only when specified in procurement.

^b If compliance for signal leads is required, it is developed on a case-by-case basis, subject to military approval.

^c For 1A, 10 relaxation = 20 log (load current).

^d For inter shield connected, or twisted pairs together; otherwise, compliance is developed on a case-by-case basis, subject to military approval.

SCHULZ: APPLICATION TABLES

5

TABLE VI
CE03 CONDUCTED EMISSIONS: POWER/INTERCONNECTING
LEADS (15 kHz-50 MHz)

EQUIPMENT CLASS						EMISSION		LIMITS			SKETCH
A1 ^a	A2	A3 ^b	A4	A5	B	EXTERNAL LEADS ^{c,d}	BM	FREQUENCY RANGE	(f in MHz)	UNITS	
X	X	A				Ac/dc power, control	NB	15 kHz - 2 MHz	A) 29.3 - 31.1 log f	dBμA	
		N	X	X	X	≤ 1A dc, control ≤ 1A 400 Hz ≤ 1A 60 Hz ≤ 1A dc, control, signal			B) 26.4 - 21.2 log f C) 25.0 - 16.8 log f		
X	X	A				Ac/dc power, control		2 - 50 MHz	D) 20		
		N	X	X	X	≤ 1A: dc, 60 Hz, 400 Hz; control, signal					
X	X	A				≤ 1A dc, control	BB	15 kHz - 2 MHz	E) 62.5 - 41.4 log f F) 61.2 - 37.2 log f	dBμA/MHz	
		N	X	X	X	Ac/dc power, control			G) 60.5 - 35.0 log f H) 57.6 - 25.4 log f I) 56.4 - 21.2 log f		
X	X	A				Ac/dc power, control		2 - 50 MHz	J) 50		
		N	X	X	X	≤ 1A: dc, 60 Hz, 400 Hz; Control, signal					

^a For Army, use LHM of MIL-STD-462.
^b Compliance for signal leads is developed, subject to approval, on a case-by-case basis (exception, Note d).
^c Limits given for ≤ 1A max. for > 1A, be relaxed between 15 kHz and 2 MHz by: dB relaxation = (2.83 - 9.41 log f) log (load current).
^d For Classes A3, A4, A5, applicable for outer shield connected or twisted pairs together; otherwise, compliance is developed on a case-by-case basis, subject to approval, as for Class B.

TABLE VII
CE06 CONDUCTED EMISSIONS: ANTENNA TERMINALS
(10 kHz-12.4 GHz; Dependent on Tx f₀)

APPLICATIONS: Equipment subsystems designed for use with antennas.
 LIMITATIONS: a. Not applicable to Tx f₀ with Pavg > 1.0 W (or 2.0 W for Army, with Pavg > 5 W), or b. f₀ > 1.24 GHz.
 or c. Integral antenna, or d. otherwise at < 1.24 GHz, instead use CE07.
 b. For Army, not applicable to Class B unless specified in procurement.

EQUIPMENT CLASS						EMISSION		LIMITS			EQUIPMENT RANGE	PPREP TEST FREQUENCY
A1	A2	A3	A4	A5	B	EMISSIONS TYPE	BM	FREQUENCY RANGE	P - Peak power at f ₀	UNITS		
X	X	X	X	X	X	Re, Tx key up	NB	10 kHz - f ₀	14	180V	10-100 kHz	10 MHz
						Tx key down	BB		40	180V/MHz	100-1000 kHz	100 MHz
						Spurious	NB	10-100 f ₀ - 100 MHz	-40	180V	1-10 MHz	1 MHz
						Harmonics 1-3		10 f ₀ - 100 MHz	-40	180V	10-100 MHz	1 MHz
						Harmonics 2, 3		2 f ₀ - 100 MHz	-40	180V	10-100 MHz	10-100 MHz

TABLE VIII
CE07 CONDUCTED EMISSIONS: POWER LEADS, SPIKES
(Time Domain)

APPLICATIONS: Multiconductor cable with high frequency in power leads.
 LIMITATIONS: a. Applicable to Class B, in 4-wire cables and cables for Army, only when specified in procurement.

EQUIPMENT CLASS						EMISSION		LIMITS		
A1	A2	A3	A4	A5	B	SITUATION	TYPE	V _{pk} - Peak Voltage	UNITS	
X	X	X	X	X	X	Ac power leads	Transient	100 V _{pk}	Open	
						Ac power leads		100 V _{pk} - 100 V _{pk}		

TABLE IX
CS01 CONDUCTED SUSCEPTIBILITY: POWER LEADS
(30 Hz-50 kHz)

Application. Equipment/subsystem external power leads, including ground and neutral not internally grounded.
Limitation. With Command approval, may be deleted if no internal-circuit sensitivity ≤ 100 mV. For Army, not applicable to Class B unless specified in procurement.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	FREQUENCY RANGE ^c	SOURCE REQUIREMENT ^a (Volts rms) (f in kHz)(V_1 : line voltage)	V_1	SKETCH
X X X X X X	30 Hz - 1.5 kHz	0.1 V_1 3 0.1 V_1 5	430 >30 450 >50	
X X X X X X	1.5 - 50 kHz	(9.00 - 5.91 log f) 0.01 V_1 (9.00 - 5.91 log f) 0.01 V_1 3.0 + (-0.116 + 0.657 log f)(0.01 V_1 - 3) 5.0 + (-0.116 + 0.657 log f)(0.01 V_1 - 5) 3.2 - 1.31 log f 5.5 - 2.63 log f	430 450 30-100 50-100 ≥100 ≥100	
X X X X X X				
X X X X X X				

^aFor Army, not applicable for dc leads.

^bSame, unless specified in procurement.

^c $f < 0.95 f_0$, $> 1.05 f_0$; f_0 is fundamental frequency of test item.

^dAlternate: When source cannot develop required voltage at test item after having been adjusted to dissipate 50 W in 0.5-ohm load, test item is considered not susceptible.

TABLE X
CS02 CONDUCTED SUSCEPTIBILITY: POWER INPUT TERMINALS
(50 kHz-400 MHz)

Application. Equipment/subsystem power input terminals, including grounds and neutrals not internally grounded.
Limitation. For Army, not applicable to Class B unless specified in procurement.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	FREQUENCY RANGE	SOURCE REQUIREMENT ^a (Volts rms)
X X X X X X	50 kHz - 400 MHz	1 V, 50-ohm source

^a Alternate: When 1 W, 50- Ω source cannot develop required voltage and test item shows no response, item is not considered susceptible.

TABLE XI
CS03 CONDUCTED SUSCEPTIBILITY: INTERMODULATION,
TWO SIGNAL (30 Hz-10 GHz)

Application. Receiving equipment/subsystems: receivers, RF amplifiers, transceivers, etc.
Limitation. For Army, not applicable to Classes A2, A3, B unless specified in procurement.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	FREQUENCY RANGE ^a	SOURCE REQUIREMENT (dB > std reference)	
		No. 1 (modulated)	No. 2 (CW)
X X X X X X	30 Hz - 2 MHz	66	66 (but ≤ 10 dBm)
X X X X X X	2 - 25 MHz ^b	80	
X X X X X X	5 - 200 MHz ^b	66	
X X X X X X	200 - 400 MHz ^b	80	
X X X X X X	0.4 - 10 GHz	66	

^a Dependent upon operating frequency range of test item, as follows: from higher of 0.1 f_0 or 30 Hz to smaller of 10 f_0 or 10 GHz, where f_0 is the tuned frequency.

^b This range not applicable to test items operating within the range.

SCHULZ: APPLICATION TABLES

7

TABLE XII
CS04 CONDUCTED SUSCEPTIBILITY: INPUT-TERMINAL
SPURIOUS REJECTION, TWO SIGNALS
(30 Hz-10 GHz)

Application: Receiving equipment/subsystems: receivers, RF amplifiers, transceivers, etc.
Limitation: For Army, not applicable to Classes A2, A3, B unless specified in procurement.
Applicability for Class B to be determined on a case-by-case basis.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	FREQUENCY RANGE ^a		SOURCE REQUIREMENT ^b (Source off f_0)	
	LOWER FREQ. ^c (<10 Hz)	UPPER FREQ. ^c (<10 GHz)	RECEIVERS	AMPLIFIERS
X X X X X X	Lesser of $1f/5$, $0.05 f_1$ f_2 f_3 $f_3 = BW/2$	Greater of $5 f_{LO} + 1f$, $20 f_2$ f_2 $f_2 = BW/2$	0 dB ↓ 50 dB above f_1 source	Amplifier technical requirement, or control plan, else, 0 dB N/A

SYMBOL	RECEIVER	AMPLIFIER
f_0	Tuned frequency	Band center
f_1	Lowest [tunable frequency]	Low [end of passband]
f_2	Highest [of band in use]	High [end of passband]
BW	40-dB-dBW bandwidth	

^a For waveguide input, $40.8 f_{LO}$ (cutoff).
^b For multiple conversion, IF is lowest used.
^c For multiple conversion, IF is highest used.
^d Source at f_0 set for standard response. Other source (off f_0) as indicated. Both sources modulated as per MIL-STD-462.

TABLE XIII
CS05 CONDUCTED SUSCEPTIBILITY: CROSS MODULATION
(30 Hz-1 GHz)

Application: Receiving equipment/subsystems: receivers, RF amplifiers, transceivers, etc.
Limitation: For Army, not applicable for Classes A2, A3, and B unless in procurement.
Applicability for Class B determined on a case-by-case basis.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	FREQUENCY RANGE		SOURCE REQUIREMENT (Scanning)	
	LOW f	HIGH f	Receivers	Amplifiers
X X X X X X	$f_0 - 1f$ (≥ 30 Hz)	$f_0 + 1f$ (≤ 10 GHz)	66 dB > std response (but ≤ 10 dBm)	N/A ^a

^a Current test procedure of MIL-STD-462 does not apply to RF amplifiers.

TABLE XIV
CS06 CONDUCTED SUSCEPTIBILITY: POWER-LEAD SPIKES

Application: Spikes on ac/dc power leads, including grounds and neutrals not internally grounded.
Limitation: For varistor-protected power inputs, requirement is also met for spike peak voltage equal to maximum safe level of varistor.

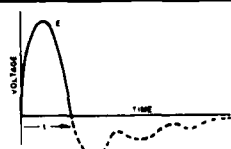
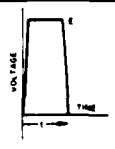
EQUIPMENT CLASS A1 A2 A3 A4 A5 B	SOURCE REQUIREMENT (SPIKE TRANSIENT)			
	PEAK (Volts)	TIME TO ZERO (μ s)	WAVESHAPE	(ALTERNATE)
X N A AP	100 ↓ 200 ↓ 400	≤ 0.15 ≤ 10 ≤ 0.15 ↓ ≤ 10 ≤ 5		

TABLE XV
CS07 CONDUCTED SUSCEPTIBILITY: SQUELCH CIRCUITS

Application: Receiving equipment/subsystems utilizing squelch circuits.
Limitations: None.

EQUIPMENT CLASS A1 A2 A3 A4 A5 B	SOURCE REQUIREMENTS (Two Tests)	
	(a) IMPULSE	(b) SIMULTANEOUS SOURCES
X X X X X X	90 dBuV/MHz	(1) CW, f_0 , $V=2/3$ squelch threshold (2) Impulse: 50dbuV/MHz

Application. Navy equipment/subsystems where $f_o \leq 100$ kHz and sensitivity $\leq 1\mu V$ (such as $0.5\mu V$).

Limitation. Applicable test points to be specified.


EQUIPMENT CLASS					FREQUENCY RANGE	SOURCE REQUIREMENT		
A1	A2	A3	A4	A5		(f in kHz)	UNITS	SKETCH
N	N	N	N	N	60-400 Hz 0.4-20 kHz 20-100 kHz	120 $116. - 10.0 \log f$ $183.0 - 61.5 \log f$	dBuA	

Applications. Magnetic fields emitted by cases and cables of equipment/subsystems; not antennas.

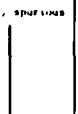




Limitations. Class A1: ASW aircraft only.

Class A2: On a case-by-case basis only.

Class A3: Navy fixed/mobile ground facilities; otherwise, on a case-by-case basis.

EQUIPMENT CLASS						E M I S S I O N			L I M I T S		
A1	A2	A3	A4	A5	A B	TYPE	BW	FREQ. RANGE	(f in kHz)	UNITS	SKETCH
X	X	N	X	X		$f_0, n f_0$, spurious ↓	NB ↓	30 Hz - 30 kHz 30 - 50 kHz	$79.1 - 40.0 \log f$ 20	dBpT ↓	

Applications. Electric fields emitted by uses and cables of equipment's subsystems; not intenses.
Limitations. Upper frequency for broadband emissions is 1 MHz.
For Army, not applicable to Tables B unless specified in the document.

EQUIPMENT CLASS						E M I - 1 - 1 - 1		E M I - 1 - 1 - 1		
A1	A2	A3	A4	A5	H	TYPE	RF	FREQ. RANGE	LOSS	REFLECTION
abc - def a b c						$E_{01}, H_{01}, \text{spurious}$ 	VB	14 MHz - 25 MHz 	$A1: 26.5 = 4.63 \log f$ $H1: 36.5 = 4.63 \log f$ $V1: 46.5 = 4.63 \log f$ $A1: 11.5 = 35.4 \log f$ $H1: 6.5 = 35.4 \log f$ $V1: 36.5 = 35.4 \log f$	$18\alpha = 0$ 
$X^2 = X$ $N = X \times X$ $AF = AF$ X <hr/> $X^2 = X$ $N = X \times X$ $AF = AF$ X							DB	14 MHz - 25 MHz 	$A1: 26.5 = 4.63 \log f$ $H1: 36.5 = 4.63 \log f$ $V1: 46.5 = 4.63 \log f$ $A1: 11.5 = 35.4 \log f$ $H1: 6.5 = 35.4 \log f$ $V1: 36.5 = 35.4 \log f$	$18\alpha = 0$ 
$A1 = A$ $A2 = N$ $A3 = X$ $A4 = X$ $A5 = X$ $H = X$ <hr/> $A1 = A$ $A2 = N$ $A3 = X$ $A4 = X$ $A5 = X$ $H = X$										

a = wave loss with $P_{avg} = 100$, value limit by P_{avg}
b = power frequency, 4.57 MHz
c = manually initiated operational switching transients
d = army, includes manually-operated switching transients.

Source Requirement. See CS06.

TABLE XXII
[RS03] RADIATED SUSCEPTIBILITY: ELECTRIC FIELD
(14 kHz-40 GHz)

Application. Equipment/subsystems.
Limitations. For 10 GHz < f < 40 GHz, applicable only to intentional emitters on aircraft (Class A), spacecraft and launch vehicles (Class A2), and ships (Class A4).
Note special requirements for non-metallic aircraft or structures (Class A1).
For Navy receiving sites (Class A3), the source requirement is 1 V/m at all frequencies.
For Army, applicable to Class B only when specified on procurement.

EQUIPMENT CLASS						FREQUENCY RANGE	SOURCE REQUIREMENT ^{a,b}		UNITS
A1	A2	A3	A4	A5	B		FIRST	SECOND	
A		A				14 kHz - 2 MHz	1		V/m
N	X	N				↓	10		
AF		AF				2 - 30 MHz	10		
X		X				30 MHz - 2 GHz	5		
						2 - 10 GHz	5		
						↓	40		
						10 - 40 GHz	20		
						↓	40		
N						14 kHz - 40 GHz	200 (non-metallic aircraft, structures)		
AF						↓			
			X			14 kHz - 30 MHz	1 (below deck)	100 (above deck)	
						30 MHz - >10 GHz	1 (below deck)	200 (above deck)	
			X			14 kHz - 1 GHz	1		
					X	14 kHz - 10 GHz	1		

^a Above 30 MHz, the requirement is for both horizontal and vertical polarization.

^b Consider operational EM environment (See MIL-HDBK-235). Values here are minimum. Substantially higher values may require modifying procedures of MIL-STD-462, to be described in EMC Test Plan.

TABLE XXIII
[UM04] CONDUCTED AND RADIATED EMISSIONS AND RADIATED
SUSCEPTIBILITY: ENGINE GENERATORS/COMPONENTS
IN, OR POWERING, CRITICAL AREAS

Applications. Engine generators and associated components, uninterruptible power sets (UPS) and mobile electric power (MEP) equipment supplying power to, or used in, critical areas (Class C2), in the following groups:
I. 12 items with ratings ≤ 240 kVA
II. 12 items with ratings > 240 kVA
III. Engine generators with electronic circuitry (for regulation, control, stability, etc.)
Limitation. Above 30 MHz, radiated limits apply for both horizontal and vertical antennas at 1-m distance. Applicable to Group II items when specified by Command or agency concerned.

GROUP	REQUIREMENT		FREQUENCY RANGE	LIMITS		SKETCH
	TYPE	BN		IF (MHz)	UNITS	
I, II, III	Conducted Emissions: Power Leads Radiated Emissions	BB	15 kHz - 1 MHz	73.1 - 10.7 log f	dBμA @ 10m	
		BB	14 kHz - 25 MHz	110.2 - 7.68 log f	dBμV @ 10m	
	Radiated Susceptibility	NB	25 - 50 MHz	118.0 - 59.4 log f	V/m	
		NB	100 MHz - 1 GHz	73	V/m	
			2 - 400 MHz	73	V/m	
			0.4 - 10 GHz	5	V/m	

SCHULZ: APPLICATION TABLES

11

TABLE XXIV
[UMOS] RADIATED EMISSIONS: TACTICAL AND SPECIAL-PURPOSE VEHICLES AND ENGINE-DRIVEN EQUIPMENT

Application. Tactical/special-purpose vehicles and engine-driven equipment, including electrical equipment and attached parts (Equipment Class CII).

GROUP I		GROUP II	
Crash rescue trucks	Patrol boats	Motorcycles	Maintenance and service trucks/vans
Wheeled vehicles, tactical	Gun motor carriage	Harbor tugs	Earth augers
Armored and tracked vehicles	Railway maintenance-of-way equipment	Fork-lift trucks	General purpose and construction equipment: cranes, bulldozers, pumps, etc.
Off-the-road cargo carriers	Storm boats	Autoboard motors	Replacement engines for above
Armored personnel carriers	Heaters, gasoline	Floodlight trailers	
Assault and landing craft	Replacement engines for above	Cargo handling equipment	
Amphibious vehicles		Engine-driven air conditioners	

GROUP III

Administrative vehicles basically civilian in nature: sedans, delivery trucks, ambulances, fire trucks, etc.

Limitation. Above 30 MHz, limits apply to both horizontal and vertical polarization.

GROUP	EMISSION	FREQUENCY RANGE	(f in MHz)	LIMITS	UNITS	SKETCH
I, II, III	BB	0.15 - 200 MHz	$79.7 + 10.7 \log f$	180 V/m/MHz		
		1.5 - 200 MHz	$5.6 + 21.5 \log f$			
		0.2 - 0.4 GHz				
		0.2 - 1 GHz				

^aUpon Command or agency approval, not applicable to items for use solely in non-critical areas.

^bGroup I requirements applicable to items with electronic equipment, mobile telephone or communications.

TABLE XXV
[UMOS] CONDUCTED AND RADIATED EMISSIONS: COMMERCIAL ELECTRICAL/ELECTROMECHANICAL EQUIPMENT AND SUBSYSTEMS

Applicability. Primarily Group I commercial electrical/electromechanical equipment procured for use in critical areas.

GROUP I		GROUP II	
Portable electric tools: saws, drills, rivet guns, etc.	Heaters (all types)	Fixed/semi-portable machine tools: lathes, stamping presses, etc.	
Repair/maintenance shop equipment	Lithographic/photo equipment	Arc welders	
Facilities equipment: air conditioners, elevators, etc.	Battery chargers	Engine generators for construction or shop support	
Reperforators	Fixed kitchen/commissary equipment		
Projectors and flash units	Office equipment		
	Vending machines		
	Laundry/dry-cleaning equipment		

GROUP III

Inherently interference-free items.

Limitations. Not applicable to:

- Group I items procured for use in non-critical areas.
- Group II items unless specified. Warning label required to prohibit use < 30 m (100 ft) from electronic equipment/subsystems/associated antennas.
- Group III if justified and approved, and only if not procured as component of another equipment/subsystem.

REQUIREMENT		LIMITS		SKETCH
TYPE	SW	FREQUENCY RANGE	(f in MHz)	
Conducted Emissions: Power Leads	BB	50 kHz - 2 MHz	$41.1 + 17.5 \log f$	
Radiated Emissions ^a		0.15 - 200 MHz	$100.0 + 10.9 \log f$	
		200 - 400 MHz	$25.5 + 21.5 \log f$	

^aFor portable electric tools, add 15 dBuV/m/MHz.

APPENDIX B

**DoD COMMUNICATIONS STANDARDS
CONTAINING NO SPECIFIC EMC PROVISION**

TABLE B-1
DOD COMMUNICATIONS STANDARDS CONTAINING NO SPECIFIC EMC PROVISION^a
(Page 1 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Mendments	Scheduled Updates	Superseded Documents
MIL-STD-188-100 11/15/72 Common Long Haul and Tactical Communication System Technical Standards	Mandatory for all DoD. (DCA)	System, subsystems, and equipment standards pertinent to multichannel communications circuits, which traverse both long-haul and tactical communications systems. To be used in the design and installation of new communications facilities for both systems and is common to both systems, unless stated otherwise. In addition, for tactical systems, this standard is to be used for the operation of new communications facilities.	Notice 1, 7/16/75 Notice 4 (Proposed), 10/6/78		MIL-STD-188- 101 DCA Circular 330-175-1 (3.2.1-3.2.1, 3.1.2.7)
MIL-STD-188-114 3/24/76 Electrical Characteristics of Digital Interface Circuits	Mandatory for all DoD. (DCA)	Specifies electrical characteristics of the unbalanced voltage and the unbalanced voltage digital interface circuits employed for the interchange of serial binary signals among Data Terminal Equipments (DTE) and Data Communications Equipments (DCE) or in any interconnection of binary signals between voice or data equipments. Does not specify other characteristics of the DTE/DCE interface (see MIL-STD-188-100).			MIL-STD-188- 100, (4.3.1.3) MIL-STD-188C, (7.2.1)
MIL-STD-188-120 5/15/76 Terms and Definitions	Approved for all DoD. (USACEEIA)	Terms selected from standards in MIL-STD-188 series. Intent is to include such terms here rather than in individual standards of the series. Terms are listed in spoken word order.		To be superseded by FED-STD-1037.	MIL-STD-188-C (Section 2) and MIL-STD- 188-100 (Appendix F)
MIL-STD-188-161 1/30/81 Design Standards for Common Long-Haul and Tactical Facsimile Equipment	(DCA)	Establishes technical design standards for digital facsimile equipment to be used over both long- haul and tactical communications networks. Operation over both 4-KHz analog voice channels and digital circuits is addressed.			
MIL-STD-188-311 12/10/71 Technical Design Standards for Frequency Division Multiplexers	Mandatory for all DoD. (RADC)	Establishes electrical performance requirements for FDM equipment used in the DCS and semi-fixed tactical service. Defines the interface levels at inter-connection points to and from local telephone facilities and to and from long- distance communication trunks.			DDAC 330-175- 1 (3.2.5-3.2.5, 8.2.3)
MIL-STD-188-315 7/30/71 Subsystem Design and Engineering and Equipment Technical Design Standards for Wire Systems	Mandatory for all DoD. (USACEEIA)	Provides technical design and engineering standards for broadband cable circuits common to analog/frequency-division systems in the long-haul communications system of DoD (DCS) and the National Military Communications System (NMCS) or to the authorized upgrading of existing DCS and NMCS subsystems. Submarine cables and installations are not included.			DDAC 330-175- 1 (3.2.3-3.2.3, 2.3.23)

^aNote: The -100 series is common to both tactical and long-haul systems.
The -200 series applies to tactical systems only.
The -300 series applies to long-haul systems only.

TABLE B-1
(Page 2 of 2)

Number-Date Title	Intended Use (Author)	Scope/Purpose	Notices/ Amendments	Scheduled Updates	Superseded Documents
MIL-STD-188-340 5/21/71 Equipment Technical Design Standards for Voice Order- wire Multiplex	Mandatory for all DoD.	Provides characteristics for all frequency- division orderwire multiplexers provided for the DCS for use primarily on wideband-radio transmission systems to provide up to three four-wire voice orderwire channels. These channels will be confined to the frequency spectrum below 12 kHz at the interface with the wideband radio equipment.	Notice 1, 7/28/77 Contains corrections to published standard.		
MIL-STD-188-341 2/15/71 Non-Diversity Digital Data Modems (2400 bps)	Mandatory for all DoD.	Specifies the minimum performance and interface requirements for 2400-BPS (bits per second) modems (modulator/demodulators) for use on normal 4-kHz channels meeting DCS 51, MIL-STD-3002-C2 (formerly Bell 40), or equivalent conditioning requirements. Such channels are typically derived from FDM equipment associated with LOS microwave, coaxial-cable, submarine-cable, troposcatter, and satellite transmission systems.			DCAC 330-175-1 (3.2, 4.2, 3.2, 4.2.9 and 5, 7.9, 5.4)
MIL-STD-188-342 2/25/72 Equipment Technical Design Standards for Voice Frequency Carrier Telegraph (FST)	Mandatory for all DoD. (RADC)	Provides the technical design standards for multi- channel, frequency-shift-keyed, voice-frequency, carrier telegraph (VFC) terminals, which operate at rates not exceeding 75 bits per second. Intended use is in the design and installation of new VFC equipment and also in the upgrading of existing equipment used in long-haul communications.			
MIL-STD-188-344 6/1/72 Non-Diversity Digital Data Modems, 1200 Bits Per Second	Mandatory for all DoD. (RADC)	Specifies the minimum performance and interface requirements for 1200 BPS (bits per second) modems (modulator/demodulators) for use on nominal 4-kHz channels meeting AUTODIN 3-2, Bell 3002-C2 (formerly Bell 40), or equivalent conditioning requirements. Typically, such channels are derived from FDM equipment associated with LOS microwave, coaxial-cable, troposcatter, and satellite transmission systems.			
MIL-STD-188-346 11/30/73 Equipment Technical Design Standards for Analog End Instruments and Central Office Ancillary Devices	Approved for all DoD. (USACE/EA)	Establishes design standards for analog end instruments and central-office ancillary devices used in long-haul communications systems within the Defense Communications System (DCS) and the National Military Command System (NMCS).			DCAC 330-175-1 (3.4, 3.4.3, 4.3, 4)
MIL-STD-188-347 3/29/73 Equipment Technical Design Standards for Digital End Instruments and Ancillary Devices	Approved for all DoD. (USACE/EA)	Provides technical design standards and test criteria for digital end instruments and ancillary devices for use in the terminal area of a long-haul communications system. This standard is approved for use in designing, installing, and operating new communications facilities, and in upgrading existing subsystems and equipment.			DCAC 330-175-1 (3.4.1 and 3, 4.4)

CITATIONS INDEXES
CITATIONS ALPHA-NUMERIC INDEX

		EMC STANDARDS HANDBOOK		November 1982 REVISION DATE	I-1 SECTION-PAGE
<u>No.</u>	<u>Subject</u>	<u>Type^a</u>	<u>Page</u>		
ANS C63.2	Instrumentation	R	2-22		
C63.4	Equipment EMC	M	2-22		
C63.12	EMC Control	G,L	2-22		
C95.1	RADHAZ: Personnel	L	2-22		
C95.2	RADHAZ Warning Symbol	R	2-22		
C95.3	RADHAZ Techniques/Instrumentation	M	2-22		
C95.4	RADHAZ: Electro-Explosives	G,L	2-23		
C112.1	Vehicle RF Radiation	L,M	2-23		
Z136.1	RADHAZ: Lasers	L	2-23		
BS 613	Suppression Components/Filters	M,R	3-8		
727	Instrumentation	R	3-8		
800	Limits, RFI	L	3-8		
827	Trolley-Buses/Tramways: RFI Suppression	L	3-8		
833	Ignition System RF Emission	L,M	3-8		

^aSYMBOLS

C: Criteria for Design
D: Definitions
G: Guidance
L: Limits

M: Measurement Methods
P: Program
R: Requirements

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-2

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
905	TV/VHF Sound Receivers	L,M	3-8
1597	Shipboard RFI Suppression	L,M	3-9
3549	TV Receiver Performance	M	3-9
C22.4 No. 101	Instrumentation/Accessories	R	3-7
104	Vehicle RF Radiation	L,M	3-7
106	ISM RF Emissions	L	3-7
107	Wire Communications/Signal Systems	L,M	3-7
C108.1.1	Instrumentation: CISPR Type	R	3-7
.3.1	HVAC Power Systems	L,M	3-7
.5.4	LV Apparatus: Conducted EMI	L,M	3-7
CBEMA/ESCS-77-29	Computers/EDP Equipment: RF Emissions	L,M	2-23
CCIR 239	Receivers, TV Broadcast: Spurious Emissions	L,M	4-10
258-1	Man-Made Radio Noise Measurement	M	4-10
329-2	Spurious Radiation	D,L,M	4-10
334-1	Receivers, TV Broadcast: Impulsive Interference	M	4-10
378-1	Field-Strength Monitoring Accuracy		4-10
442	Field-Strength Measurement: Monitoring Station	M	4-10
443	Measurement Methods	M	4-10
CISPR 1	Instrumentation (0.15-30 MHz)	R	4-10
2	Instrumentation (25-300 MHz)	R	4-11
3	Instrumentation (10-150 kHz)	R	4-11
4	Instrumentation (300-1000 MHz)	R	4-11
5	Instrumentation Detectors (not Quasi-Peak)	R	4-11
6	Instrumentation: AF Voltmeter	R	4-11

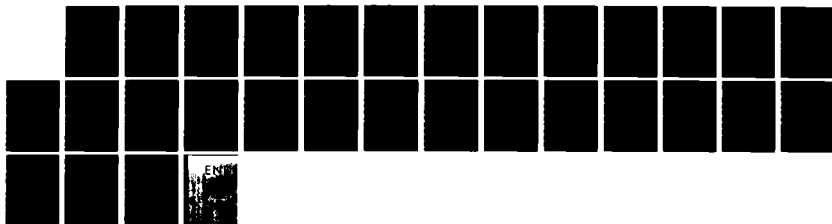
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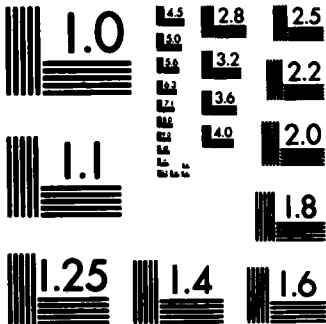
EMC (ELECTROMAGNETIC COMPATIBILITY) STANDARDS HANDBOOK
REVISION 4(U) ELECTROMAGNETIC COMPATIBILITY ANALYSIS
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NATIONAL BUREAU OF STANDARDS-1963-A

EMC STANDARDS HANDBOOK

November 1982
REVISION DATE

I-3
SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
7	Suppression Recommendations	G	4-11
8	CISPR Reports/Study Questions	G	4-11
9	RFI and Leakage Currents	L	4-11
10	CISPR Organization, Rules, Procedures		4-11
11	ISM RF Emission	L,M	4-12
12	Vehicle RF Radiation: Ignition	L,M	4-12
13	Sound/TV Receivers	L,M	4-12
14	Household/Portable Electric Appliances/Tools	L,M	4-12
15	Florescent Lamps/Luminaires	L,M	4-12
16	Instrumentation/Measurement Methods	R,M	4-12
17	Filter Performance, EMC	M	4-12
CP 327-201	Sound/TV Broadcast Reception	G	3-9
1001	Vehicle RF Radiation	G	3-9
1002	Industrial/Medical Equipment Suppression	G	3-9
1006	General Suppression	G	3-9
CR-1, RSC	ISM RF Emissions: Regulations (Canada)	L	3-7
EIA EMC-3	Equipment Testing and Measurement Techniques	M	2-25
IEB 10C	Microwave Systems EMC Criteria	R	2-25
RS 152B	Land-Mobile Transmitter Emissions, FM/PM	D,M	2-23
163	RF Radiation Label (FCC 15)	R	2-23
204B	Land-Mobile Receiver Characteristics, FM/PM	D,M	2-23
316B	Portable/Personal Transmitters/ Receivers, FM/PM	R	2-24
361	Capacitors, Feed-Through	R	2-24

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-4

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
378	Receiver FM/TV Broadcast: Spurious	G,M	2-24
388	Land-Mobile Communications Equipment, FM/PM	M	2-24
416	Filters, EMC	R	2-24
450	Measurement Reporting Form (FCC 15)	R	2-24
TR 8.10	Vehicle Ignition Susceptibility-Measurement Correlation		2-24
TR 8.12	Vehicle Electronic Equipment (non-Communications)		2-25
EPA 520/7-73-001	Measurement Capabilities, RF Radiation	G	2-17
520/1-74-005	ATC Radar Spectral Measurements	Data	2-17
FAA 6.050.17A	Frequency-Management Principles	G	2-18
DABS	Discrete-Address Beacon System	R	2-18
ER-350-023	ATC Equipment: Grounding/Bonding/Shielding	R	2-18
-024	ATC Buildings: Grounding/Bonding/Shielding	R	2-18
FCC 15	Incidental/Restricted-Radiation Devices	R	2-17
FCC 18	Industrial/Scientific/Medical Devices	R	2-17
FED-STD-1033	Digital Communication Performance	R	2-17
IEC 106	Receivers/AM, FM, TV Transmitter Spurious Emissions	M	4-4
107	Receivers, TV Broadcast: RF Measurements	M	4-4
215	Transmitters: Safety Requirements	M	4-4
244 (Parts 1-7)	Transmitters: Various Signal Classes	M	4-4/5
315 (Parts 1-3, 5, 8)	Receivers: Various Signal Classes	M	4-6
437	HV Insulators, RFI Tests	M	4-7
469 (Parts 1,2)	Pulse Techniques/Apparatus	D,M	4-7

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-5

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
489 (Parts 1-7)	Mobile Radio: Various Signal Classes	D,M	4-7/8
510 (Parts 1,2)	Satellite Earth Station Equipment/Subsystems	M	4-8
512 (Part 9)	Electromechanical Components for Equipment	M	4-9
533	Shipboard EMC		4-9
Chap. 902	Definitions: EMC	D	4-9
IEEE 100	Definitions: Electrical/Electronics Terms	D	2-25
139	ISM Field-Strength Measurement	M	2-25
140	RF Heating Equipment	G	2-25
184	Receivers, FM Mobile Communications	D,M	2-25
185	Receivers, FM Broadcast	D,M	2-26
186	Receivers, AM Broadcast	D,M	2-26
187	Receivers, FM/TV Broadcast: Spurious Radiation	G,M	2-26
213	Receivers, FM/TV Broadcast: Emissions to Powerline	M	2-26
214	LISN Construction Drawings	R	2-26
263	Vehicle RF Radiation	M	2-26
284	Field-Strength Measurement	G,M	2-27
291	Field Strength, Radio-Wave Propagated	G,M	2-27
294	Noise-Generator Temperature Measurement	G,M	2-27
299	Shielded-Enclosure Performance	M	2-27
302	Field Strength, EM, under 1 GHz	M	2-27
368	HVDC Electrical Noise/Harmonic Filter Performance	M	2-27
376	Impulse Strength/Bandwidth	D,M	2-27
377	Land-Mobile Transmitter Spurious Emissions	M	2-27

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-6

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
430	Overhead Powerline Radio Noise	M	2-28
469	Distribution Transformer Voice-Frequency Electrical	M	2-28
	Noise		
521	RF Bands: Letter Designators	G	2-28
539	Overhead Powerline Corona/Radio-Noise Terms	D	2-28
644	AC Powerline E and H Fields	M	2-28
IME Pub. 20	RADHAZ Prevention: Explosives	G,L	2-28
ISO 1540	Aircraft Electrical Systems		4-9
2650	Aircraft Equipment Environmental Tests: Part I Scope/		4-9
	Applicability		
2676	Aircraft Equipment Environmental Tests: Part 4.1		4-9
	Magnetic Influence		
TR 3352	Acoustic Noise Assessment on Speech Intelligibility		4-9
MDS-201-0004	Medical Devices	R,M	2-18
MIL-A-17161C	RF Absorber	C	2-5
MIL-B-5087B (ASG)	Bonding/Lightning Protection (Aerospace)	C,M	2-5
MIL-C-85485	Cable, RF Absorptive	R	2-5
MIL-E-6051D	Systems EMC	R	2-6
MIL-G-46875	Gasket Material, RF	R	2-6
MIL-HDBK-235-1A (NAVY)	EM Environment, Protection	G	2-6
-237A	Platforms/Systems EMC for Managers	G	2-6
-238 (NAVY)	RADHAZ: Personnel	G	2-8
-241A	Power Supply EMI Reduction	G	2-6

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-7

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
-253	Systems EMC Design and Test	G	2-6
-411A	Power/Air Conditioning	G	2-10
-417	TROPO Facility Design	G	2-10
MIL-STD-188C			
-188-100	Tactical Communications: Basic Standards	R	2-9
-114	Long-Haul/Tactical Communications: Common Requirements	R	C-2
-120	Digital Interface Circuits	R	C-2
-124	Definitions: Communications Terms	D	C-2
-161	Communications: Grounding/Bonding/Shielding	R	2-9
-310A	Facsimile Equipment	R	C-2
-311	Technical Control Facilities	C	2-9
-313	Frequency-Division Multiplexers	R	C-2
-315	LOS/TROPO Radio Design	R	2-9
-317	Wire Systems	R	C-2
-322	HF Radio Design	R	2-10
-340	Digital Microwave Transmission, LOS	R	2-10
-341	Voice Order-Wire Multiplex	R	C-3
-342	Digital Data Modems, Non-Diversity	R	C-3
-344	Voice-Frequency Carrier Telegraph (FSK)	R	C-3
-346	Digital Modems, Non-Diversity: 1200 BPS	R	C-3
-347	Analog End Instruments/Ancillary Devices	R	C-3
-220A	Digital End Instruments/Ancillary Devices	R	C-3
-285	Filter Insertion Loss	M	2-3
	Shielded-Enclosure Performance	M	2-3

EMC STANDARDS HANDBOOK

November 1982
REVISION DATE

I-8
SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
-449D	Equipment RF Characteristics	M	2-3
-454F	Equipment Overall Requirements	R	2-11
-461B	Emission, Susceptibility	L	2-3
-462	Emission, Susceptibility	M	2-3
-463A	Definitions, EMC	D	2-4
-469	Radar EMC Criteria	C,M	2-4
-704D	Aircraft Electric Power	R	2-11
-1310D (NAVY)	Bonding/Grounding (Shipboard)	C	2-4
-1337B (SHIPS)	Portable Electrical Tools, EMC Design	C	2-4
-1377 (NAVY)	Cable/Weapon Shielding, Filtering	M	2-7
-1385 (NAVY)	RADHAZ: Ordnance	R	2-7
-1388A	RADHAZ: Personnel/Fuels (Shipboard)	L	2-8
-1399A, Sec. 408	RADHAZ: Personnel/Fuels (Shipboard)	R	2-8
-1463 (AR)	RADHAZ: Munitions	L	2-11
-1512	RADHAZ: Electro-explosives Design	R	2-11
-1541 (USAF)	Space Systems EMC	R	2-5
-1542 (USAF)	Space Systems Ground Facilities	R	2-5
-1572	Firing-Range Telemetry	G	2-12
-1605 (SHIPS)	EMI Survey (Shipboard)	M	2-5
-1686	Electrostatic-Discharge Protection	P	2-12
-1695	Environment/Static Electricity	L	2-12
-1757	Lightning Qualification (Aerospace)	M	2-5
-1857	Grounding, Bonding, Shielding	C	2-5

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-9

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
NAT-STD-3456	Aircraft Electric Power	R	2-14
-3516	Aircraft Equipment EMC	L,M	2-14
-3614	Aircraft Systems EMC	L,M	2-14
-3659	Aircraft Lightning Protection	R	2-14
-4006	Tactical Vehicles: Shielded Spark Plugs/Ignition	R	2-14
	Cables		
NEMA WD2	Lamp Dimmers, Solid-State		2-28
107	HV Apparatus, Radio-Influence Voltage	M	2-28
NFPA 77	Static Electricity	G	2-28
78	Lightning-Protection Code	R	2-28
NTIA Manual	Frequency Management	G,R	2-17
OSHA 29 CFR 1910.97	RADHAZ: Personnel		2-18
RS-161 (Canada)	Airborne Equipment Interference	L,M	3-7
RTCA D0160A	Airborne Equipment Environmental Tests	M	2-29
168	Emergency-Locator Transmitters	R	2-29
176	Airborne Equipment: Interference from FM Broadcast		2-29
SAE AIR 1147	Aircraft EMI from Jet-Engine Charging	G	2-29
1208	Lightning and Precipitation Static: Bibliography	G	2-29
1209	Parallel-Plate Line: Construction/Calibration	G	2-29
1221	Systems EMC Design Checklist	G	2-29
1255	Spectrum Analyzer for EMC	G	2-29
1394	Cabling Guidelines for EMC	G	2-30
1404	Gaskets, DC/RF Impedance	G	2-30

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-10

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
1406	Lightning Protection/Static Electrification	G	2-30
1423	Gas-Turbine EMC: Aircraft	G	2-30
1425	Gas-Turbine EMC: Land Vehicles	G	2-30
1500	Filters, Lossy: Bibliography	G	2-30
1509	Instrumentation Antennas/Antenna Factors	G	2-30
ARP 935	Control Plan, EMI: Outline	G	2-30
936	Capacitor, 10 μ f, for EMC Measurements	R	2-30
937	Aircraft EMI from Jet-Engine Ignition	R	2-30
958	Instrumentation Antennas, Broadband: Calibration	R	2-30
1172	Filters		2-31
1173	Gaskets: RF Shielding	M	2-31
1267	Impulse Generators: Calibration	R,M	2-31
1285	Electrical Connectors: Shielding	M	2-31
1705	Gaskets: Coaxial Test Procedure	M	2-31
J551g	Vehicle RF Radiation	L,M	2-31
J1113a	Vehicle Component Susceptibility (Non-Aircraft)	M	2-31
J1338	Vehicle RF Susceptibility (Whole-Vehicle)	M	2-31
SAMA PMC 33.1	Process-Control Instrumentation: EMC	M	2-32
33.2	Process-Control Instrumentation: Susceptibility to Powerline Disturbances	M	2-32
TO 31Z-10-4 (AF)	RADHAZ: Personnel/Fuel/Explosives	G,L	B-2
/FM 11-490-30 (ARMY)	Suppression Components	R	3-4
VDE 0565			

EMC
STANDARDS HANDBOOK

November 1982

REVISION DATE

I-11/12

SECTION-PAGE

<u>No.</u>	<u>Subject</u>	<u>Type</u>	<u>Page</u>
0871	ISM RFI Suppression	R	3-4
0872	Receivers, Radio/TV	R	3-4
0874	Interference Suppression Guidelines	G	3-4
0875	Household Appliances: Unintentional RF	R	3-4
0876	Instrumentation	R	3-5
0877	RF Voltage/Field Strength	M	3-5
0879	Vehicle Interference Suppression	R	3-5

EMC STANDARDS HANDBOOK

November 1982

I-13

REVISION DATE

SECTION-PAGE

CITATIONS SUBJECT INDEX

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
AC Powerline E and H Fields	M	IEEE 644	2-28
Acoustic Noise Assessment on Speech Intelligibility		ISO TR 3352	4-9
Aerospace: ATC Bldgs., Grounding/Bonding/Shielding	R	FAA ER-350-024	2-18
ATC Equipment, Grounding/Bonding/Shielding	R	FAA-ER-350-023	2-18
ATC Radar Spectral Measurements	Data	EPA 520/1-74-005	2-17
Discrete Address Beacon System	R	FAA DABS	2-18
Electric Power	R	MIL-STD-704D	2-11
	R	NAT-STD-3456	2-14
Electrical Systems	R	ISO 1540	4-9
Emergency-Locator Transmitter	R	RTCA DO168	2-29
Equipment EMC	L,M	NAT-STD-3516	2-14
	M	RS-161	3-7
Environmental Tests	M	RTCA DO160A	2-29
Environmental Tests/Scope, Applicability		ISO 2650	4-9
Environmental Tests/Magnetic Influence		ISO 2676	4-9
Interference from FM Broadcast		RTCA DO176	2-29
Jet Engines/Gas Turbines	(See same)		
Lightning Protection	(See Lightning)		
Systems EMC	L,M	NAT-STD-3614	2-14
	(see also Systems)		
Bonding/Grounding	(See specific system; Grounding)		
Cable, RF Absorptive	R	MIL-C-85485	2-5

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-14

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Cable/Weapon Shielding, Filtering	M	MIL-STD-1377 (NAVY)	2-7
Cabling Guidelines for EMC	G	SAE AIR 1394	2-30
Capacitor, 10 μ f, for EMC Measurements	R	SAE ARP 936	2-30
Capacitors, Feed-Through	R	EIA RS 361	2-24
CISPR Organization, Rules, Procedures		CISPR 10	4-11
Reports/Study Questions	G	CISPR 8	4-11
Communications:			
Analog End Instruments/Ancillary Devices	R	MIL-STD-188-346	C-3
Definitions of Terms	D	MIL-STD-188-120	C-2
Digital Data Modems, Non-Diversity	R	MIL-STD-188-341	C-3
, 1200 BPS	R	MIL-STD-188-344	C-3
End Instruments/Ancillary Devices	R	MIL-STD-188-347	C-3
Interface Circuits	R	MIL-STD-188-114	C-2
Microwave Transmission, LOS	R	MIL-STD-188-322	2-10
Performance	R	FED-STD-1033	2-17
Facsimile Equipment	R	MIL-STD-188-161	C-2
Frequency-Division Multiplexers	R	MIL-STD-188-311	C-2
Grounding/Bonding/Shielding	R	MIL-STD-188-124	2-9
HF Radio Design	R	MIL-STD-188-317	2-10
Land Mobile/Mobile	(See same)		
Long-Haul/Tactical: Common Requirements	R	MIL-STD-188-100	C-2
LOS/TROPO Radio Design	R	MIL-STD-188-313	2-9
Microwave Systems EMC Criteria	R	EIA IEB 10C	2-25

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-15

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Tactical: Basic Standards	R	MIL-STD-188C	2-9
Technical Control Facilities	C	MIL-STD-188-310A	2-9
TROPO Facility Design	G	MIL-HDBK-417	2-10
Voice-Frequency Carrier Telegraph (FSK)	R	MIL-STD-188-342	C-3
Voice Order-Wire Multiplex	R	MIL-STD-188-340	C-3
Wire/Signal Systems	L,M	C22.4 No. 107	3-7
Wire Systems	R	MIL-STD-188-315	C-2
Computers/EDP Equipment: RF Emissions	L,M	CBEMA/ESC5-77-29	2-23
Connectors, Electrical: Shielding	M	SAE ARP 1285	2-31
Control Plan, EMI: Outline	G	SAE ARP 935	2-30
Definitions:			
Communications Terms	(See Communications)		
Electrical/Electronics Terms	D	IEEE 100	2-25
EMC Terms	D	MIL-STD-463A	2-4
Overhead Powerline Corona/Radio-Noise Terms	(See Electrical)		
Electrical Distribution Transformer: Electrical Noise	M	IEEE 469	2-28
HV Apparatus, Radio Influence Voltage	M	NEMA 107	2-28
HV Insulators: RFI Tests	M	IEC 437	4-7
HVAC Systems	L,M	C108.3.1	3-7
HVAC Electrical Noise/Harmonics Filter Perf.	M	IEEE 368	2-27
LV Apparatus, Conducted EMI	L,M	C108.5.4	3-7
Overhead Powerline Corona/Radio-Noise Terms	D	IEEE 539	2-28
Radio Noise	M	IEEE 430	2-28

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-16

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Power/Air-Conditioning	G	MIL-HDBK-411A	2-10
Supply EMI Reduction	G	MIL-HDBK-241A	2-6
Electromechanical Components for Equipment	M	IEC 512 (Part 9)	4-9
EM Environment, Protection	G	MIL-HDBK-235-1A (NAVY)	2-6
EMC Control	G,L	ANS C63.12	2-22
Emission, Susceptibility Limits	L	MIL-STD-461B	2-3
	L	BS 800	3-8
Measurement Methods	M	CCIR 443	4-10
	M	MIL-STD-462	2-3
	M	VDE 0877	3-5
Equipment EMC	M	ANS C63.4	2-22
Overall Requirements	R	MIL-STD-454F	2-11
RF Characteristics	M	MIL-STD-449D	2-3
Testing and Measurement Techniques	M	EIA EMC 3	2-25
Field Strength, EM, Under 1 GHz	M	IEEE 302	2-27
Measurement	G,M	IEEE 284	2-27
Measurement: Monitoring Stations	M	CCIR 442	4-10
Monitoring Accuracy		CCIR 378-1	4-10
Radio-Wave Propagated	G,M	IEEE 291	2-27
Filters: EMC	R	EIA RS 416	2-24
		SAE ARP 1172	2-31
Insertion Loss	M	MIL-STD-220A	2-3

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-17

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Lossy: Bibliography	G	SAE AIR 1500	2-30
Performance	M	CISPR 17	4-12
Firing-Range Telemetry	G	MIL-STD-1572	2-12
Fluorescent Lamps, Luminaires	L,M	CISPR 15	4-12
Frequency Management	G,R	NTIA Manual	2-17
Principles	G	FAA 6.050.17A	2-18
Gaskets, RF: DC/RF Impedance	G	SAE AIR 1404	2-30
Coaxial Test Procedure	M	SAE ARP 1705	2-31
Material	R	MIL-G-46875	2-6
Shielding	M	SAE ARP 1173	2-31
Gas-Turbine EMC: Aircraft	G	SAE AIR 1423	2-30
Land Vehicles	G	SAE AIR 1425	2-30
Grounding/Bonding, Shielding	C	MIL-STD-1857	2-5
		(Also see specific systems)	
Household Appliances: Unintentional RF	R	VDE 0875	3-4
Portable Electric Appliances/Tools	L,M	CISPR 14	4-12
Ignition-System RF Emissions	L,M	BS 833	3-8
		(See also Vehicles, Aerospace)	
Impulse Generators: Calibration	R,M	SAE ARP 1267	2-31
Strength/Bandwidth	D,M	IEEE 376	2-27
Incidental/Restricted-Radiation Devices	R	FCC 15	2-17
Industrial/Medical Equipment Suppression	G	CP 1002	3-9
ISM (Industrial/Scientific/Medical) Devices	R	FCC 18	2-17

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Field-Strength Measurement	M	IEEE 139	2-25
RF Emissions	L	C22.4, NO. 106	3-7
	L,M	CISPR 11	4-12
Regulations	L	CR-1, RSC	3-7
RFI Suppression	R	VDE 0871	3-4
Instrumentation	R	ANS C63.2	2-22
	R	BS 727	3-8
	R	VDE 0876	3-5
(10-150 kHz)	R	CISPR 3	4-11
(0.15-30 MHz)	R	CISPR 1	4-11
(25-300 MHz)	R	CISPR 2	4-11
(300-1000 MHz)	R	CISPR 4	4-11
Accessories	R	C22.4 NO. 101	3-7
AF Voltmeter	R	CISPR 6	4-11
Antennas/Antenna Factors	G	SAE AIR 1509	2-30
, Broadband: Calibration		SAE ARP 958	2-30
CISPR Type	R	C108.1.1	3-7
Detectors (not Quasi-Peak)	R	CISPR 5	4-11
/Measurement Methods	R,M	CISPR 16	4-12
Spectrum Analyzers	G	SAE AIR 1255	2-29
Interference-Suppression Guidelines	G	VDE 0874	3-4
Jet-Engine Charging	G	SAE AIR 1147	2-29
Ignition Interference		SAE ARP 937	2-30

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-19

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Lamp Dimmers, Solid-State		NEMA WD2	2-28
Land-Mobile Communications Equipment, FM/PM	M	EIA RS 388	2-24
Receiver Characteristics, FM/PM	D,M	EIA RS 204B	2-23
Transmitter Emissions, FM/PM	D,M	EIA RS 152B	2-23
Spurious Emissions	M	IEEE 377	2-27
Lightning Qualification (Aerospace)	M	MIL-STD-1757	2-5
/Precipitation Static: Bibliography	G	SAE AIR 1208	2-29
Protection	C,M	MIL-B-5087B(ASG)	2-5
	R	NAT-STD-3659	2-14
	R	NFPA 78	2-28
	G	SAE AIR 1406	2-30
	R	IEEE 214	2-26
LISN Construction Drawings	M	CCIR 258-1	4-10
Man-Made Radio-Noise Measurement	R,M	MDS-201-0004	2-18
Medical Devices	D,M	IEC 489 (Parts 1-7)	4-7/8
Mobile Radio: Various Signal Classes	G,M	IEEE 294	2-27
Noise-Generator Temperature Measurements	G	SAE AIR 1209	2-29
Parallel-Plate Line: Construction/Calibration	M	SAMA PMC 33.1	2-32
PCI (Process-Control Instrumentation) EMC	M	SAMA PMC 33.2	2-32
Susceptibility to Powerline Disturbances	G	MIL-HDBK-237A	2-6
Platforms/Systems EMC for Managers	C	MIL-STD-1337B	2-4
Portable Electric Tools, EMC Design		(SHIPS)	
/Personal Transmitters/Receivers, FM/PM	R	EIA RS 316B	2-24

EMC STANDARDS HANDBOOK

November 1982
REVISION DATE

I-20
SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Pulse Techniques/Apparatus	D,M	IEC 469 (Parts 1, 2)	4-7
Radar EMC Criteria	C,M	MIL-STD-469	2-4
	C,G	NTIA Manual	2-17
RADHAZ: Electro-Explosives	G,L	ANS C95.4	2-23
	R	MIL-STD-1512	2-11
Lasers	L	ANS Z136.1	2-23
Ordnance	L	MIL-STD-1463 (AR)	2-11
	R	MIL-STD-1385 (NAVY)	2-7
Personnel	L	ANS C95.1	2-22
	G	MIL-HDBK-238 (NAVY)	2-8
	L	OSHA 29 CFR 1910.97	2-18
/Fuels (Shipboard)	G,L	MIL-STD-1388A	2-8
/Fuel/Explosives	R	TO 31Z-10-4 (AF)	B-2
		/FM 11-480-30 (ARMY)	
		MIL-STD-1399A,	2-8
		Sec. 408	
Prevention: Explosives	G,L	IME Pub. 20	2-28
Techniques/Instrumentation	M	ANS C95.3	2-22
Warning Symbol	R	ANS C95.2	2-22
Receivers, AM Broadcast	D,M	IEEE 186	2-26
/AM, FM, TV Transmitter Spurious Emissions	M	IEC 106	4-4
FM Broadcast	D,M	IEEE 185	2-26
FM Mobile Communications	D,M	IEEE 184	2-25

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-21

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
FM/TV Broadcast: Emissions to Powerline	M	IEEE 213	2-26
Spurious Radiation	G,M	EIA RS 378	2-24
Radio/TV	G,M	IEEE 187	2-26
Sound/TV	R	VDE 0872	3-4
	L,M	BS 905	3-8
	L,M	CISPR 13	4-12
Broadcast Reception	G	CP 327-201	3-9
TV Broadcast: Impulsive Interference	M	CCIR 334-1	4-10
RF Measurements	M	IEC 107	4-4
Spurious Emissions	L,M	CCIR 239	4-10
Performance	M	BS 3549	3-9
Various Signal Classes	M	IEC 315 (Parts 1-3, 5,8)	4-6
RF Absorber	C	MIL-A-17161C	2-5
Bands: Letter Designators	G	IEEE 521	2-28
Heating Equipment	G	IEEE 140	2-25
Radiation Label (FCC 15)	R	EIA RS 163	2-23
Measurement Capabilities	G	EPA 520/7-73-001	2-17
Reporting Form (FCC 15)	R	EIA RS 450	2-24
RFI and Leakage Currents	L	CISPR 9	4-11
Satellite Earth Station Equipment/Subsystems	M	IEC 510 (Parts 1,2)	4-8
Shielded-Enclosure Performance	M	IEEE 299	2-27
	M	MIL-STD-285	2-3

EMC STANDARDS HANDBOOK

November 1982

REVISION DATE

I-22

SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Shipboard Bonding/Grounding	C	MIL-STD-1310D	2-4
EMC		IEC 533	4-9
EMI Survey	M	MIL-STD-1605 (SHIPS)	2-5
RADHAZ	(See RADHAZ)		
RFI Suppression	L,M	BS 1597	3-9
Space Systems EMC	R	MIL-STD-1541 (USAF)	2-5
Ground Facilities	R	MIL-STD-1542 (USAF)	2-5
Static Electricity	G	NFPA 77	2-28
Electronic Discharge Protection	P	MIL-STD-1686	2-12
Environment	L	MIL-STD-1695	2-12
Suppression: Components	R	VDE 0565	3-4
/Filters	M,R	BS 613	3-8
General	G	CP 1006	3-9
Recommendations	G	CISPR 7	4-11
Systems EMC	R	MIL-E-6051D	2-6
Design Checklist	G	SAE AIR 1221	2-29
Test	G	MIL-HDBK-253-1A (NAVY)	2-6
Transmitters: Safety Requirements	M	IEC 215	4-4
Spurious Radiation	D,L,M	CCIR 329-2	4-10
	(See also Receivers)		

EMC
STANDARDS HANDBOOK

November 1982
REVISION DATE

I-23/24
SECTION-PAGE

<u>Subject</u>	<u>Type</u>	<u>No.</u>	<u>Page</u>
Various Signal Classes	M	IEC 244 (Parts 1-7)	4-4/5
Vehicle Component Susceptibility (non-Aircraft)	M	SAE J1113A	2-31
Electronic Equipment (non-Communications)		EIA TR 8.12	2-25
Interference Suppression	R	VDE 0879	3-5
RF Radiation	L, M	ANS C112.1	2-23
	L, M	C22.4 No. 104	3-7
	G	CP 1001	3-9
	M	IEEE 263	2-26
	L, M	SAE J551g	2-31
	L, M	CISPR 12	4-12
	M	SAE J1338	2-31
Susceptibility: (Whole-Vehicle)		EIA TR 8.10	2-24
-Measurement Correlation (Ignition)		NAT-STD-4006	2-14
Tactical: Shielded Ignition System	R		
Trolley-Buses/Tramways, RFI Suppression	L	BS 827	3-8

LIST OF REFERENCES

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